Respirology (2007) **12**, 100–103 doi: 10.1111/j.1400-1843.2006.00949.x

ORIGINAL ARTICLE

Influenza and rhinovirus infections among health-care workers

Nancy BELLEI, Emerson CARRARO, Ana Helena Sitta PEROSA, Daniela BENFICA AND Celso Fransisco Hernandes GRANATO

Clinical Virology Laboratory of Infectious Diseases Unit of Sao Paulo Hospital, Sao Paulo Federal University, Sao Paulo, Brazil

Influenza and rhinovirus infections among health-care workers
BELLEI N, CARRARO E, PEROSA AHS, BENFICA D, GRANATO CFH. *Respirology* 2007; **12**: 100–103
Background and objective: Health-care workers (HCWs) are at higher risk of acquisition and transmission of respiratory virus infections. Nosocomial transmission of influenza has been documented but whether this is so for other respiratory viruses has not been assessed.
Methods: Epidemiological, clinical and viral laboratory surveillance was carried out on HCWs presenting with acute respiratory infection in a university hospital.
Results: Over a 2-year period, 203 subjects were recruited: rhinovirus was the most frequently detected virus (37.7% in flu negative samples) and influenza A/B was positive in only 12.3% of subjects. Only 19.7% of HCWs were immunized against influenza. High detection of rhinovirus occurred even during the peak of the influenza season and half of the infected subjects reported an influenza-like illness.
Conclusion: Rhinovirus infection occurred frequently in this study population and probably contributes to influenza misdiagnosis. Educational interventions about different viruses causing respiratory symptoms and an increase in standards of infection control besides influenza immunization among HCWs is needed.

Key words: health-care worker, immunization, influenza, respiratory infection, rhinovirus.

INTRODUCTION

Viral respiratory infections are responsible for a large proportion of medical care including utilization of emergency centre facilities and hospitalizations. Nosocomial spread of these agents follows a seasonal pattern, with the peak incidence in winter months, reflecting the disease activity in the community.[1]

Influenza infection is of great concern given the significant morbidity and mortality that ensues. Health-care workers (HCWs) are at high risk of influenza infection due to their exposure to ill patients, as well as their exposure to the general community.[2] Vaccination of HCWs has been shown to reduce the incidence of influenza among them and results in prevention of disease transmission to patients.[3] However, vaccine access and misconceptions regarding the vaccine efficacy and possible side-effects are associated with non-vaccination in some studies.[4] Influenza immunization effectiveness is related to local influenza activity and laboratory documentation of other viral infections may be helpful to clarify concerns about exclusive influenza prophylaxis conferred by vaccine among HCWs.[2] Other viruses usually more related to common cold clinical presentation may account for some misconception. In this context, Boivin *et al.*[5] reported the role of picornaviruses in flu-like illnesses in adults. Epidemiology surveys in Brazil have highlighted the role of rhinovirus as a very frequent cause of respiratory disease.[6] In addition, rhinovirus infection appears to result in a higher morbidity and mortality than usually seen with the common cold.[7]

To address this, a study of HCWs from a university hospital was undertaken to assess the aetiology of respiratory viral infections, their clinical presentation

Correspondence: Nancy C.J. Bellei, Virology Laboratory, Division of Infectious Diseases, Universidade Federal de São Paulo, Rua Pedro de Toledo, 781 15° andar, CEP 04039-032, São Paulo—SP, Brazil.
Email: nbellei@uol.com.br

Received 20 December 2005; invited to revise 27 January 2006; revised 3 February 2006; accepted 12 May 2006 (Associate Editor: Se Hwa Yoo).

and the level of influenza vaccination in the largest urban area in South America.

METHODS

Subjects

From June 2001 to September 2003 employees from Sao Paulo Hospital—Sao Paulo Federal University—were recruited following a physician visit at the Health Care Worker Medical Assistance Service.

Health-care workers were categorized into the following groups: staff working in/with (i) paediatrics; (ii) immunocompromised patients, and other patients with high-risk underlying conditions for influenza complications (cardiovascular, pulmonary, metabolic, haematologic disease and obstetric patients); (iii) intensive care unit; (iv) emergency service; (v) surgical service (unknown risk for influenza); (vi) other hospital wards and outpatient clinics (health-care providers to patients without high risk for influenza complications); and (vii) administrative sections.

Inclusion criteria

Adults (>18 years) were considered eligible after evaluation by a physician following presentation with any acute respiratory infection of possible viral aetiology. Influenza-like illness (ILI) was considered when the patient reported: fever (measured or not) with at least one respiratory symptom (cough, sore throat, or nasal congestion) and at least one constitutional symptom (headache, malaise, myalgia, sweat or chills, or fatigue).

Respiratory viruses detection

Each patient had a nasal wash collected and direct fluorescence assay (DFA) was performed for the presence of influenza virus A and B, parainfluenza (PIV) 1, 2 and 3, adenovirus and respiratory syncytial virus (RSV) in a two step procedure (Light Diagnostics Simulfluor® Respiratory Screen and Panel, Chemicon, Canada). All negative samples for influenza DFA were tested by reverse transcription polymerase chain reaction (RT-PCR) for influenza A and B according to published methods.[8] All negative samples for influenza DFA were tested by two RT-PCR-hybridization assays for rhinovirus and coronavirus according to published methods.[9]

Epidemiological and clinical data

Study patients were interviewed by the research staff and information including demographic data, household children contact, place of work, type of patient assistance (direct or indirect contact), history of symptoms, clinical presentation, comorbidities, smoking and influenza vaccination status collected.

RESULTS

Subjects

A total of 203 HCWs were recruited, 73.9% female, mean age 36 years (18–68). Analysis of exposure risk according to the pattern of patient care or children contact revealed that 48.3% had direct contact with patients and 39.4% had preschool children exposure either at the health service or at home. Baseline characteristics, epidemiological and health status are shown in Table 1.

Influenza prophylaxis

Thirty-one per cent reported (63/203) influenza vaccination in the past, but only 19.7% (40/203) were vaccinated for the current season. The remaining subjects were immunized in previous seasons but were not routinely revaccinated. Influenza immunization rates were highest among HCWs from surgery unit (28.6%) and lowest among care providers for patients without high risk for influenza complications (4.3%) (Table 2). HCW health status assessed by questionnaire revealed 10.5% of subjects had underlying predisposition to influenza complications. Vaccination uptake in this high-risk group was 21% and similarly low rate (20%) was obtained for smokers (10/50).

Virological and clinical data

Nasal washings from 203 patients tested by DFA resulted in 17.8% positivity: 22 cases of influenza A/B (12.3%), RSV 4% and PIV 1.5%. Negative influenza samples were also tested by RT-PCR for influenza, rhinovirus and coronavirus. No additional samples were positive for influenza A/B on RT-PCR. Rhinovirus

Table 1 Characteristics and health status of 203 HCWs investigated at the Sao Paulo Hospital

Characteristics	Cases (%)
Median age, years (range)	36 (18–68)
Female gender	152 (73.9)
Smoker	50 (24.6)
Exposure to children (<5 years)	80 (39.4)
Patient contact	98 (48.3)
Health status	
No comorbidities	116 (57.1)
Rhinitis/sinusitis	54 (26.6)
Asthma	6 (3.0)
Others lung diseases	6 (3.0)
Diabetes mellitus	4 (2.0)
Hypertension	30 (14.8)
Cardiovascular disease	3 (1.5)
Hypothyroidism	1 (0.5)
Anaemia	1 (0.5)

HCWs, health-care workers.

Table 2 Vaccine uptake and viral infection rates among various staff groups involving 203 health-care workers

Staff category	Patients (*n*)	Vaccine[†]	Influenza	Rhinovirus[‡]
All staff	203	40 (19.7)	22 (12.3)	63 (37.7)
Paediatric unit	21	5 (23.8)	1 (4.8)	11 (52.4)
Surgical unit	7	2 (28.6)	3 (42.8)	2 (28.6)
Care providers for high-risk patients§	38	8 (21.0)	5 (13.2)	13 (34.2)
Intensive Care Unit	9	1 (11.1)	2 (22.2)	3 (33.3)
Emergency room	8	2 (25.0)	0 (0)	3 (37.5)
Care providers for-non-high-risk patients	23	1 (4.3)	3 (13.0)	4 (17.4)
Others	97	15 (15.5)	8 (8.2)	27 (27.8)

[†]Vaccine refers to influenza immunization.

[‡]Rhinovirus-positive results by reverse transcription polymerase chain reaction among 167 influenza direct fluorescence assay-negative results.

[§]High-risk included personnel who provide health care to cardiovascular, lung, metabolic, haematological diseases, obstetric and immunocompromised patients.

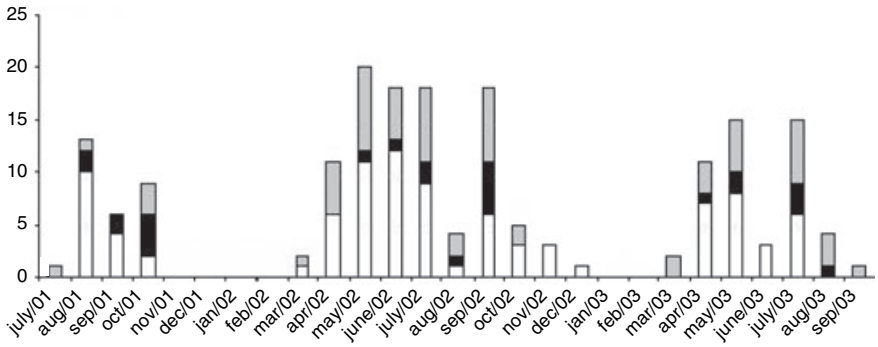

Figure 1 Laboratory-confirmed viral infection cases in a survey among health-care workers at Sao Paulo Hospital from 2001 to 2003. (▨) Rhinovirus, (■) influenza, and (□) negative.

infection was detected in 63 cases (37.7%) of 167 DFA negative samples and Coronavirus in eight cases (4.8%). Rhinovirus had a similarly high frequency of detection even during the peak of the 2001 influenza season. During each and every month of 2002 and 2003 rhinovirus was the most prevalent, as shown on Figure 1. ILI was diagnosed in 84% of influenza infected patients but also in 49.5% of those with a positive rhinovirus test.

Table 2 shows influenza and rhinovirus infections rates according to staff category. HCWs from paediatric units were the most infected by rhinovirus (52%) and those from the surgery unit were the most infected by influenza (43%).

DISCUSSION

This is the first study assessing the aetiology of respiratory viral infection among HCWs in Brazil. Brazilian National Public Health Organizations only offers influenza vaccination to the elderly population. Some health-care institutions offer vaccination free of cost to their employees.

In the study, hospital vaccination is offered free of cost but there is no campaign programme to take up vaccination. There was a very low rate of influenza immunization among HCWs from the Sao Paulo Hospital. Previous surveys on vaccination conducted in the USA and Europe have shown that influenza immunization rates among HCWs are usually less than 30%.[10,11] There is considerable effort taken to improve influenza immunization rates among HCWs to improve patient safety particularly for those patients at high risk.[12] In this regard it is very important to understand the reasons for non-compliance to vaccination programmes. The reasons identified were fear of adverse side-effects from the vaccine, avoidance of medications and on individual belief of low susceptibility to influenza infection.[2] The major reason identified by another study of vaccination refusal in the Brazilian elderly was the misconception that the vaccine may cause influenza and the common concern about the 'non- effectiveness' to prevent 'flu and cold'.[13]

Rhinovirus was the most frequent virus detected and did not follow a typical seasonal pattern as described elsewhere. The frequency of rhinovirus infection is probably underestimated because coinfection in these influenza positive samples was not assessed. In addition, ILI clinical presentation was associated with rhinovirus infection in half of the study population and is likely to contribute to the misconceptions about influenza vaccine effectiveness, particularly during the influenza season, with there being high circulation of both viruses. As ILI in this study was the reason for a physician consultation, the high rate of these symptoms among rhinovirus

infected patients may be overestimated. The design of the study did not allow investigation of rhinovirus infection in patients with mild symptoms. However, Boivin and collaborators did assess the role of rhinoviruses as a frequent pathogen associated with important respiratory and systemic symptoms among health volunteers, during the influenza season.[5] Those results strongly suggested that rhinovirus contributed to the maintenance of the myth that inactivated influenza vaccine could cause the flu.

Evaluation of the working domains of HCWs showed that rhinoviruses were detected in half of the personnel from paediatric wards. Other studies have already highlighted the relevance of rhinoviruses among children in Brazil.[6] Rhinoviruses are mainly transmitted by hand contact and persist as an infectious source on contaminated surfaces. Hendley and collaborators demonstrated that HCWs are reluctant to practices that might avoid rhinoviruses self-inoculation.[14] In this case only contact precautions and surfaces decontamination could prevent viral transmission. Educational programmes to improve infection control measures could contribute to reduce the rate of infection.

During the study period there was low local influenza activity. A higher detection (42.9%) only occurred at the surgical unit probably due to environmental conditions (closed room) associated with suboptimal immunization. Special attention should be given to this point because possible occurrence of nosocomial transmission of influenza to these patients may account for increasing pneumonia rates in the early post surgical period. There were not a significant number of influenza cases detected among the immunized HCWs in this group or among immunized employees from other areas. It is important to point out that the original objective of our study was not to evaluate vaccine efficacy.

Analysis of vaccination uptake according to HCW category and focusing on their contact with higher risk patients for influenza complications revealed unexpected results: low rates of vaccination among health-care providers for high-risk patients (21.5%) and ICU (11%). This suggests that vaccination uptake is not dependent on knowledge of influenza epidemiology and its complications.

During low influenza activity seasons in Brazil rhinovirus is the major viral upper respiratory infection among HCWs, accounting for clinical misdiagnosis as influenza. This may contribute to low adherence to influenza vaccination practices for HCWs.

Occupational exposure to patients contributes to acquisition and transmission of rhinovirus infection and highlights the relevance of educational programmes to promote infection control measures. The same opportunity should be used to encourage influenza immunization among HCWs, particularly for those in the high-risk group context. A better understanding of epidemiological risk factors, knowledge that vaccine does not cause influenza and does not prevent other viruses as rhinovirus may improve acceptance.

ACKNOWLEDGEMENT

This work was supported by FAPESP (process number 01/125796).

REFERENCES

1 Aitken C, Jeffries DJ. Nosocomial spread of viral disease. *Clin. Microbiol. Rev.* 2001; **14**: 528–46.
2 Evans ME, Hall KL, Berry SE. Influenza control in acute care hospital. *Am. J. Infect. Control.* 1997; **25**: 357–62.
3 CDC. Prevention and control of influenza. recommendations of the Advisory Committee on Immunization Practice (ACIP). *MMWR Morb. Mortal. Wkly Rep.* 2003; **52** (RR-8): 1–36.
4 Burns VE, Ring C, Carroll D. Factors influencing influenza vaccination uptake in an elderly, community-based sample. *Vaccine* 2005; **23**: 3604–8.
5 Boivin G, Osterhaus AD, Gaudreau A, Jackson HC, Groen J, Ward P. Role of picornaviruses in flu-like illnesses of adults enrolled in an oseltamivir treatment study who had no evidence of influenza virus infection. *J. Clin. Microbiol.* 2002; **40**: 330–4.
6 Souza LS, Ramos EA, Carvalho FM *et al.* Viral respiratory infections in young children attending day care in urban Northeast Brazil. *Pediatr. Pulmonol.* 2003; **35**: 184–91.
7 Papadopoulos N, Johnston S. The rhinovirus: not such an innocent? *QJM* 2001; **94**: 1–3.
8 Cooper LA, Subbarao K. A simple restriction fragment length polymorphism-based strategy that can distinguish the internal genes of human H1N1, H3N2, and H5N1 influenza A viruses. *J. Clin. Microbiol.* 2000; **38**: 2579–83.
9 Pitkaranta A, Arruda E, Malmberg H, Hayden FG. Detection of rhinovirus in sinus brushings of patients with acute community-acquired sinusitis by reverse transcription-PCR. *J. Clin. Microbiol.* 1997; **35**: 1791–3.
10 Dash GP, Fauerbach L, Pfeiffer J *et al.* APIC position paper: improving health care worker influenza immunization rates. *Am. J. Infect. Control.* 2004; **32**: 123–5.
11 Salgado CD, Farr BM, Hall KK, Hayden FG. Influenza in the acute hospital setting. *Lancet Infect. Dis.* 2002; **2**: 145–55.
12 Simeonsson K, Summers-Bean C, Connolly A. Influenza vaccination of healthcare workers: institutional strategies for improving rates. *N. C. Med. J.* 2004; **65**: 323–9.
13 Aranda CMSS, Carvalhanas TRMP, Paiva TM, Brandileone MC. Campanha de vacinação contra influenza. *BEPA* 2004; **1**: 4–6.
14 Hendley JO, Gwaltney JM Jr. Mechanisms of transmission of rhinovirus infections. *Epidemiol. Rev.* 1988; **10**: 243–58.