

# Influenza vaccination coverage among children with high-risk medical conditions

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## Abstract

We evaluated influenza vaccination coverage in children with chronic disease at high risk of influenza complications, and the need for methods to increase parents' and pediatricians' knowledge of influenza and its prevention. The 5286 children aged less than 14 years attending our Emergency Department on Wednesdays and Sundays between 1 January and 30 April 2003 included 274 (5.2%) high-risk patients. The use of influenza vaccine during the previous three seasons had been very low, but significantly increased in the last season (2000–2001, 5.1%; 2001–2002, 12.9%; 2002–2003, 26.3%;  $p < 0.001$ ). The children with asthma or cardiac disease showed the lowest vaccination rates; their parents and primary care pediatricians had only a marginal knowledge of influenza and the benefits of its prevention. In conclusion, the delivery of influenza vaccine to children with chronic disease at high risk of influenza complications is completely inadequate, and major efforts are urgently needed to increase parents' and pediatricians' knowledge of its importance.

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## 1. Introduction

Health authorities throughout the world recommend influenza vaccination in patients with chronic severe diseases associated with an increased risk of influenza complications, including those with chronic pulmonary or cardiovascular disorders, chronic metabolic disease, chronic renal dysfunction, hemoglobinopathies or various types of immunosuppression [1–5].

However, although guidelines reporting these recommendations are published in the different countries every year before the winter season, the level of influenza vaccination coverage in high-risk subjects remains significantly lower than expected, albeit with significant differences in terms of the underlying disease, age, and geographic location [6–10]. Studies investigating the reasons underlying this poor com-

pliance have shown that the most important are that both the people with chronic diseases and health providers are insufficiently aware of the risk of influenza complications and the efficacy of annual immunisations in primary prevention [11–13]. However, most of the data regarding the use of influenza vaccine in high-risk subjects refer to adult populations, and only a few include pediatric patients [14–19].

Interestingly, one American study has shown that pediatricians' opinions can play a central role in conditioning vaccination coverage: more than 70% of the investigated hospitalised children were vaccinated if their pediatrician had recommended it, but only 3% of those who had not received such a recommendation [16]. No European data are available concerning the use of influenza vaccine in high-risk children or the attitudes of pediatricians toward influenza and its prevention in such cases.

The aim of this study was to evaluate influenza vaccination coverage in high-risk children in Italy, and verify whether or not methods to increase parents' and pediatri-

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icians' knowledge on influenza and its prevention should be implemented.

## 2. Materials and methods

### 2.1. Study population

This study, which was part of a series of surveillance studies designed to calculate the burden of influenza in pediatric age [20–22], involved all of the under-14 year old children with high-risk medical conditions at risk of influenza complications attending the Emergency Department of Milan University's Institute of Pediatrics on Wednesdays and Sundays between 1 January and 30 April 2003. The definition of high-risk conditions was restricted to those for which influenza vaccine is explicitly recommended [1–5]: asthma or other chronic pulmonary diseases, hemodynamically significant cardiac diseases, chronic metabolic diseases, chronic renal dysfunctions, sickle cell anemia and other hemoglobinopathies, immunosuppressive disorders or therapy, HIV infection, and diseases requiring long-term aspirin therapy. In the case of children with multiple qualifying attendances, only the first was included. Children aged less than 6 months were excluded because the vaccine is not recommended for this age group.

A research team member approached eligible children and their parents at the time of their attendance. The study protocol was approved by the Institutional Review Board of the University of Milan. Written informed consent of a parent or legal guardian was required, and the older children were asked for their assent. There were no refusals to participate.

### 2.2. Questionnaire

After obtaining their informed consent, the parents were administered a questionnaire (which had been created and revised after pilot testing) eliciting information regarding the demographic characteristics and medical history of the study children, their influenza vaccination status for the years 2000–2003, the factors that might affect influenza vaccination status, and the parent's reasons for it in their case. In order to determine which children were affected by high-risk medical conditions, the parents were asked whether their children had a history of asthma, bronchopulmonary dysplasia, heart disease, diabetes mellitus or other metabolic diseases, kidney disease, sickle cell anemia or other hemoglobinopathies, immunosuppressive disorders or therapy, HIV infection, long-term aspirin therapy, or other medical problems; furthermore, the children's daily medicines were ascertained. In the case of the parents who reported asthma, the diagnosis was validated by means of a detailed asthma history and a review of the medical chart.

Children were considered as having been vaccinated against influenza if they had received at least one dose of vaccine after 1 September and before 30 November in each of the

preceding three years. When the parents were not aware of the vaccine status of their child, the study personnel called the child's home the day after the visit in the Emergency Department in order to confirm with any written card or diary if the vaccine was really given. Various questions were asked in order to investigate the reasons for the children's vaccination status: all of the parents were asked whether a physician had recommended influenza vaccine for their children in the past; the parents of unvaccinated children were asked "Why is your child not vaccinated against influenza?", and were provided the potential responses of lack of awareness, inconvenience, concern about side effects, or other; and the parents of vaccinated children were asked "Why is your child vaccinated against influenza?" and offered the potential responses of physician recommendation, protection of themselves, protection of an elderly family member, previous serious influenza-like illness, or other. The parents could give only one response, and the explanations for it were documented.

The parents were also asked for the name and address of their child's primary care pediatrician, who was later contacted by telephone and asked to participate in an anonymous survey of pediatricians' opinions concerning influenza and its prevention in children with high-risk conditions. After obtaining the pediatrician's consent, a questionnaire was administered covering the respondent's experience, the use of influenza vaccine in children with different risk factors, and his/her opinions about influenza infection and its prevention. In particular, the questions concerning the use of influenza vaccine in high-risk children were: "Is influenza a severe disease in children with chronic diseases?" "For which high-risk categories is influenza prevention recommended by the health authorities?" "If you do not recommend influenza vaccination in a child with chronic disease, what are the reasons?"; the questions concerning knowledge of influenza prevention were: "How many viruses are included in the vaccine?" "What drugs are registered for influenza prevention in children aged <14 years?"; and the question eliciting their opinion concerning the personal use of influenza vaccine as health workers for whom vaccination is recommended was: "Did you undergo influenza vaccination before this winter season?" The pediatricians could give multiple responses.

### 2.3. Statistical analysis

All of the data were analysed using SAS Windows v.12. A *p* value of <0.05 was considered significant for all statistical tests. When the data were not normally distributed or were non-parametric, the Kruskal-Wallis test was used. The categorical data were analysed using contingency tables and the Chi-square or Fisher's test.

## 3. Results

The 5286 children aged less than 14 years who attended our Emergency Department during the study period (2801

Table 1  
Influenza vaccination coverage of the study children during three consecutive seasons, by chronic medical condition

High-risk conditions	2000–2001 (%)	2001–2002 (%)	2002–2003 (%)
Asthma	2/79 (2.5)	6/90 (6.7)	21/101 (20.8)
Cystic fibrosis	2/24 (8.3)*	5/24 (20.8)	10/24 (41.7)
Bronchopulmonary dysplasia	1/10 (10.0)	3/11 (27.3)	4/12 (33.3)
Hemodynamically significant cardiac disease	0/40*	3/43 (6.9)	6/47 (12.8)
Diabetes	1/14 (7.1)	2/14 (14.2)	5/14 (35.7)
Chronic renal dysfunction	2/21 (9.5)	4/24 (16.7)	8/25 (32.0)
Hemoglobinopathies	1/11 (9.1)	2/11 (18.2)	4/12 (33.3)
Primary immunodeficiency	1/10 (10.0)	2/11 (18.2)	4/11 (36.4)
Cancer	1/16 (6.3)	3/17 (17.6)	6/18 (33.3)
HIV infection	1/10 (10.0)	3/10 (30.0)	4/10 (40.0)

Number (percentages).

\*  $p < 0.05$  vs. 2002–2003 season.

Table 2  
Questionnaire administered to parents of children with chronic medical conditions at high risk of influenza complications

Question	Answer	Frequency (%)
Unvaccinated children ( $n = 202$ )	Lack of awareness	173(85.6)
	Inconvenience	11 (5.5)
	Concern about side effects	18 (8.9)
	Other	0
Vaccinated children ( $n = 72$ )	Pediatrician's recommendation	63(87.5)
	Protection of parents	6 (8.3)
	Protection of an elderly family member	2 (2.8)
	Previous serious influenza-like illness	1 (1.4)
	Other	0

males; mean age  $\pm$  S.D.  $3.39 \pm 3.08$  years) included 274 (5.2%) with evidence of chronic medical conditions at high-risk for influenza complications. Among them, 39 and 19 children were not candidate to receive the vaccine in the influenza season 2000–2001 and 2001–2002 (27 and 12 because of age  $< 6$  months and 12 and 7 because chronic medical condition was clinically absent), respectively. The most common conditions were asthma and hemodynamically significant cardiac diseases, followed by chronic renal dysfunction and cystic fibrosis.

Table 1 summarises influenza vaccination coverage of these children during three consecutive seasons. The use of influenza vaccine was very low in all three seasons, but there was an overall significant increase in the last (2000–2001, 5.1%; 2001–2002, 12.9%; 2002–2003, 26.3%;  $p < 0.001$ ). There were no significant age- or sex-related differences in any of the medical categories. All of the children who had received the vaccine at least once repeated it in the subsequent seasons. The lowest vaccination rates were observed among the children with asthma and those with hemodynamically significant cardiac diseases.

Table 2 shows the questionnaire administered to the parents of the vaccinated and unvaccinated children. The main reason the latter did not receive influenza vaccine was a lack of awareness of its benefits, whereas the main reason the former received it was pediatrician recommendation.

The primary care pediatrician questionnaire concerning influenza and its prevention was sent to 274 pediatricians, 256 (93.4%) of whom returned it correctly completed (Table 3). The majority of the primary care pediatricians did not consider influenza a severe disease even in the presence of an underlying chronic disease, and most cases were unable to list all of the high-risk conditions for which influenza vaccination is explicitly recommended.

The main reason for the lack of use of influenza vaccination was a belief that it is not very efficacious in children. The pediatricians' knowledge of influenza prevention was marginal, especially in relation to the registered drugs. Furthermore, although influenza vaccination is recommended for pediatricians, only a minority made personal use of the vaccine.

#### 4. Discussion

The results of this study demonstrate that, despite a substantial increase in the last winter season considered, the rate of delivery of influenza vaccine to children with chronic diseases at high risk of influenza complications is completely inadequate. These Italian data are in line with those reported from the United States showing that the influenza vaccination coverage of children at high risk ranges from 7% to 79%, low-

Table 3  
Questionnaire administered to pediatricians of children with chronic medical conditions at high risk of influenza complications

Question	Answer	Frequency (%)
Pediatricians' opinions concerning influenza ( <i>n</i> = 256)		
Is influenza a severe disease in children with chronic diseases?	Yes	131(51.2)
	No	125 (48.8)
For which high-risk categories is influenza prevention recommended by the health authorities?	Asthma	173(67.6)
	Chronic pulmonary diseases	231 (90.2)
	Hemodynamically significant cardiac disease	228 (89.1)
	Metabolic disease	152 (59.3)
	Chronic renal dysfunction	169 (66.0)
	Sickle cell anemia and other hemoglobinopathies	163 (63.7)
	Immunosuppressive disorder or therapy	201 (78.5)
	Long-term aspirin therapy	155 (60.5)
If you do not recommend influenza vaccination in a child with chronic disease, what are the reasons?	Influenza infection not sufficiently severe	68(26.6)
	Poor efficacy of influenza vaccines	149 (58.2)
	Concern about side effects	39 (15.2)
Pediatricians' knowledge of influenza prevention ( <i>n</i> = 256)		
How many viruses are included in the vaccine?	A	33(12.9)
	A + B	149 (58.2)
	A + B + C	74 (28.9)
What drugs are registered for influenza prevention in children aged <14 years?	Amantadine + rimantadine	119(46.5)
	Zanamivir + oseltamivir	176 (68.8)
Pediatricians' opinion concerning personal use of influenza vaccine ( <i>n</i> = 256)		
Did you undergo influenza vaccination before this winter season?	Yes	101(39.5)
	No	155 (60.5)

est in subjects with asthma, and highest in those with cystic fibrosis [8,11,14–18].

Our results also show that the low influenza vaccination coverage seems to be due to a lack of knowledge by parents and pediatricians concerning the clinical relevance of influenza and the benefits of preventing it in children with chronic underlying diseases. Furthermore, the limited importance attributed to influenza by the pediatricians involved in our study can also explain their limited personal use of influenza vaccine, a finding that is similar to those reported in a Swiss University Children's Hospital [23].

As parents are greatly influenced by their children's pediatricians when choosing vaccines, it is essential to identify the reasons underlying the unfavourable attitude of pediatricians toward influenza and its prevention. One important factor conditioning pediatricians' behaviour may be that the importance of influenza vaccination in high-risk children is mainly suggested by indirect data. Although a number of studies have shown that influenza in children with certain chronic diseases can lead to severe clinical problems, and a consequently significant increase in hospitalisation, outpatient visits and drug consumption [6,24,25], very few trials have demonstrated that influenza vaccination can significantly reduce these problems and those have mainly regarded children with asthma. Moreover, although a series of recent studies have clearly shown that the registered influenza vaccines are safe and well tolerated even in asthmatic children [3,4,26–29]; some pediatricians do not administer them because they are convinced that the vaccines themselves can cause serious adverse events. Finally, the lack of precise guidelines concerning the

characteristics of some categories of high-risk children is a real problem as the documents published by different scientific societies for the same clinical conditions are not always homogeneous [1,3,4,30].

These considerations underline the need for urgent interventions aimed at increasing parents' and pediatricians' awareness of the importance of influenza and its prevention. All of the currently available data regarding the total burden of influenza in children, and the excellent safety and tolerability of registered vaccines, must be publicised as widely as possible by the mass media and scientific societies. Furthermore, studies regarding the real impact of influenza vaccine in high-risk children have to be planned and their results immediately circulated, and scientific societies must prepare uniform guidelines capable of allowing the precise worldwide identification of the children for whom influenza vaccination should be considered mandatory. Finally, it must be remembered that children with chronic medical conditions have frequent contacts with the medical system, and therefore many opportunities for the administration of influenza vaccine. Standing orders authorising nurses to administer influenza vaccine to eligible patients have led to higher rates of influenza vaccination among high-risk adults [12,31], and may therefore also help to increase immunisation rates among children.

*Conflict of interest statement:* Appropriate informed consent was obtained, and the study was conducted in accordance with the guidelines for human experimentation specified by the authors' institution. No author has a commercial or other association that might pose a conflict of interest.

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