Influenza Vaccination in Healthy Working Adults in Russia

Observational Study of Effectiveness and Return on Investment for the Employer

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Abstract

Background: All age groups are affected by influenza infection, resulting in significant medical and economic burden. Influenza infection of healthy working adults can have a marked effect on companies due to lost work days and reduced productivity. Studies in corporate settings have shown that vaccination programmes reduce this burden, although there is a lack of data in Eastern European countries.

Objectives: To determine the effectiveness of influenza vaccination in healthy working adults in Russia and the economic benefits of such a programme from an employer's perspective.

Methods: In a prospective, non-randomized, non-placebo-controlled, observational study, healthy vaccinated and unvaccinated adults employed at the Russian Railways Public Corporation were followed for 8 months during the 2005–6 influenza season using questionnaires. A first questionnaire was administered at inclusion to collect general employee information; a second questionnaire was administered to collect data on post-vaccination adverse events; and monthly questionnaires were used to gather data on influenza-like illness (ILI). Effectiveness calculations and cost analyses were performed to evaluate the impact of the influenza vaccination programme on employee productivity and costs for the employer. The study vaccine used was the trivalent, inactivated, split vaccine Vaxigrip® (sanofi pasteur, France).

Results: A total of 1331 employees volunteered for the study: 701 were vaccinated and 630 were not. The vaccine effectiveness was 70.4% against ILI events and 80.8% against sick leave days. Assuming that employees working with ILI symptoms had a reduced level of productivity (30–70% of normal), cost savings per vaccinated employee ranged from €2.13 to €5.43.

Conclusions: This study showed that an influenza vaccination programme significantly reduced ILI episodes and absenteeism, and may provide a positive return on investment for the employer.

Background

Influenza and other acute viral respiratory infections are responsible for many illnesses and complications each year. In Russia alone, 28 million individuals are infected with these viruses annually.^[1] Influenza is a serious and highly contagious acute respiratory disease. Although some groups, such as the elderly and those with chronic respiratory conditions, are at high risk from influenza, the infection can severely affect all age groups. Data from the US show that influenza results in hospital admission of 2% of healthy adult cases and complications are fatal in 4–11% of hospitalized patients.^[2]

Because of the nature of influenza infection, epidemics produce substantial burdens on society and corporations.^[3,4] Indeed, influenza infection can impair an employee's ability to work for 3–7 days (absenteeism), and has a significant impact on work productivity.^[3,5–7] In addition, work productivity is affected by employees who continue to work while sick or by those who return to work when they have not fully recovered from their illness (presenteeism). For the patient, the financial loss can arise directly from a loss of earnings and cost of treatment if the medical expenses are not borne by companies.^[8] The employer will incur indirect monetary losses (work loss) due to employees taking time off work, their reduced productivity if they are ill at work, or the cost of replacing staff members on sick leave. In addition, employers may also incur direct health-care costs for sick employees if they are paid by the company.

Annual influenza vaccination is the most effective method of preventing influenza and, when vaccine strains are well matched with the circulating influenza viruses, vaccine effectiveness can be as high as 70–90% in healthy adults.^[5] In Russia, subsequent to the recommendation of a vaccine, the Ministry of Health organizes immunization schedules according to the various target population groups, such as transport workers. International guidelines recommend influenza vaccination for adults who are either at risk for influenza complications or are close contacts of individuals at higher risk.^[9] Vaccination can also be offered

to any adult who wants to reduce the risk of becoming ill with influenza or of transmitting it to others. However, it is clear that there are also marked economic benefits from influenza vaccine prophylaxis to corporations due to the reduction of influenza-related absenteeism.^[10–13] Moreover, several studies have shown a shorter mean duration of work absence in the event of influenza infection in vaccinated workers than in unvaccinated individuals.^[14–16] The severity of symptoms of influenza-like illness (ILI) in vaccinated and unvaccinated workers has not yet been confirmed.

Our study was conducted in Russia, which has a considerable number of large companies concerned about loss of productivity. A previous retrospective economic study was conducted in 1999 to investigate the effectiveness and economic effect of funding an influenza programme in the working population of the southern district of Moscow.^[17] Free influenza vaccination was offered to 89 800 employees at 445 companies, institutions and organizations in the region. On average, 48% of personnel were vaccinated. The study demonstrated that, even in the absence of an epidemic, vaccination in the workplace was associated with a reduction of ILI and lost work time.^[17] The authors stated that they would welcome an in-depth economic study to support both their results and the implementation of a national or regional influenza vaccination programme in Russia.

Our study focused on the pharmacoeconomics of influenza vaccination in healthy working employees of the Russian Railways Public Corporation (RRPC), which is one of the three largest rail transport organizations in the world, with 1 300 000 employees. RRPC workers are subject to recommended vaccination against influenza under the national schedule of prophylactic immunization for epidemiological indications, as laid down by Order No. 229 of the Ministry of Health of the Russian Federation (27 June 2001), which advises influenza vaccination for professional risk groups, including transport. Despite this recommendation, vaccine coverage rates are low: 20% on average in Russia in 2008, higher in the 7- to 17-year-old population, where vaccina-

tion is covered by the federal budget, and lower in the adult population for whom influenza vaccination is not funded.^[18] The objectives of the present study were to determine the effectiveness of influenza vaccination and to investigate whether an influenza vaccination programme has a positive return on investment for the employer. RRPC was chosen for this study because of the risk of significant financial losses due to reduced working capacity and the high number of employees (more than 1 100 000 individuals in 2005).

Materials and Methods

Study Design

This was an observational, prospective, non-randomized, non-placebo-controlled, health economic study conducted in RRPC, the largest Russian transport company, during the 2005–6 influenza season. RRPC is a national company with branches in all regions of the Russian Federation. RRPC offers annual influenza vaccination to its employees and vaccinates approximately 500 000 employees every year. In the present study, influenza vaccination was offered to all employees from Yaroslavl city, Central Russia, through advertisements within the organization. A controlled study design would not have been consistent with respecting an employee's decision to receive or not to receive vaccination. The study compared vaccinated and unvaccinated individuals using a self-selection method.

Eligible participants were aged 18–64 years, and were in full-time employment involved directly in transport activities. Individuals were excluded from the study if they had a contraindication to vaccination, had experienced an episode of ILI in the previous 3 months or had already been vaccinated during winter 2005. ILI was defined as a rise in body temperature above 37.5°C lasting ≥2 days, accompanied by at least one generalized symptom (fever, rigors or myal-

gia) and one respiratory symptom (coryza, sore throat, cough or hoarseness).^[19]

The study vaccine used was the trivalent, inactivated, split-virion vaccine Vaxigrip® (sanofi pasteur, Lyon, France), which contained the inactivated influenza virus strains recommended by the WHO for the 2005–6 epidemic season in the Northern hemisphere. The vaccine was available in two formulations: single-dose syringes and multidose ampoules (ten doses).

Both groups were followed up for 8 months from October 2005 to May 2006, inclusively. During this time, subjects underwent a monthly medical examination by the GPs at the RRPC's medical service. Three questionnaires (see the appendix in the Supplemental Digital Content 1, <http://links.adisonline.com/APZ/A28>) were completed by the subject or the investigating physician. Questionnaire 1 was completed at the time of subject enrolment, and collected general information on the subject and their family: socio-demographic characteristics, socio-professional level, health condition, life habits and history of influenza vaccination. Questionnaire 2 was completed only for the vaccinated cohort 1 week post-immunization, and recorded vaccination adverse events, medical needs related to adverse events and sick leave. Questionnaire 3 was completed monthly throughout the follow-up period by a physician following a face-to-face meeting with the subject, which totalled eight completed questionnaires per subject. Recorded information comprised the course of any ILI episodes experienced, including symptoms, medical needs and sick leave, days of work lost through illness other than ILI (sick leave general tendency), household influenza symptoms and their impact, and vaccination status to confirm that unvaccinated individuals had not received an influenza vaccination elsewhere.

Vaccine Effectiveness Evaluation

The efficacy of vaccination was calculated according to equation 1:

$$\text{Effectiveness of vaccine (\%)} = \frac{(X \text{ in the non-vaccinated group}/N_{nv} - X \text{ in the vaccinated group}/N_v)}{(X \text{ in the non-vaccinated group}/N_{nv})} \quad (\text{Eq. 1})$$

where X is the number of ILI events, number of days with ILI symptoms or number of sick leave days; N_{nv} is the non-vaccinated cohort size and N_v is the vaccinated cohort size.

Cost Analysis

The aim of the cost analysis was to balance the vaccination costs paid by the employer (vaccine and administration costs charged to the employer, administration time for personnel, time lost for employees to get vaccinated, cost of adverse events after vaccination) with the economic vaccination benefits (avoided costs of absenteeism, personnel replacement and reduced production) from the employer's perspective. The global cost savings of the influenza vaccination programme was calculated as economic vaccination benefits minus vaccination costs.

Absenteeism was estimated from missed working days due to ILI or to adverse events associated with vaccination plus the time that was lost getting vaccinated. If an employee was replaced, it was assumed that there was no loss in productivity. Presenteeism was estimated for all subjects working with ILI symptoms, i.e. those with ILI not having sick leave at all and those coming back to work but without having recovered completely from ILI symptoms. Keech et al.^[7] previously reported that people with influenza symptoms believed they were working at 46% of their maximum effectiveness on average. Three assumptions were made and tested for reduced productivity in order to calculate the impact of presenteeism of one ILI subject going to work: sick employees were assumed to work at 30%, 50% or 70% of their normal productivity.

The impact of absenteeism and presenteeism on the total productivity of the company was assessed using the daily individual operating income of RRPC. RRPC operating income was defined as the company's revenue less the costs of goods sold and related operating expenses. It was calculated per day per employee. These parameters reflect the contribution of each employee to the global productivity of the company and therefore also reflect the global impact of an employee when he or she is absent.

Absenteeism costs linked to ILI symptoms were calculated differently depending on whether or not the absent employee was replaced:

- if not replaced: number of days out of work $\times$ (individual daily labour cost + individual operating income);
- if replaced: number of days out of work $\times$ (individual daily labour cost + individual daily labour cost of replacement).

Presenteeism costs were calculated as the number of days worked with ILI, adjusted with the 30%, 50% or 70% assumption of reduced productivity, as shown in equation 2:

$$\text{Number of days at work with ILI symptoms} \times \text{\% of reduced productivity} \times (\text{individual daily labour cost} + \text{individual operating income})$$

(Eq. 2)

All costs were in € (May 2006 rate: €1 = 34.7 rubles). Data related to RRPC were obtained from the Human Resources Department and the Health Department. The economic parameters are described in table I. Medical costs were not included in the calculations as they were not paid by the RRPC.

Statistics

The quantitative and qualitative data for the two groups in the study (vaccinated and non-vaccinated) were compared using dispersion analysis (ANOVA) or, when ANOVA was not applicable, non-parametric tests (Mann-Whitney, Wilcoxon). Chi-squared tests for categorical variables and Student's t-tests for continuous variables, or their non-parametric equivalents, were also used to compare the two groups.

Multivariate and univariate analyses were used to assess the effect of some subject characteristics on the clinical and economic study results.

Results

Patient Demographics

Of the 1122367 individuals employed by RRPC in 2005, 1331 healthy adult volunteers were included in the study. Of these, 701 (52.7%) received a single dose of Vaxigrip® vaccine and 630 (47.3%) were not vaccinated, acting as the control group. The demographic and baseline

Table 1. Sources and calculations for cost-analysis data considered in the base case and their respective monetary value

Economic variables	Economic calculation (including operating income)
Direct vaccination programme costs	
Costs of vaccines and materials	Purchasing price
Costs of administration of vaccines by occupational health personnel	Time × hourly labour costs
Indirect vaccination programme costs	
Cost of average time lost by vaccinated employees during administration	Time (10–15 min) ^a × (hourly labour costs ^b + individual hourly operating income ^b)
Cost of time lost due to adverse events	Time × (daily labour costs ^b + daily individual operating income ^b)
Indirect ILI costs	
Cost of sick leave due to ILI when the employees are not replaced	Number of days out of work × (daily labour costs ^b + daily individual operating income ^b)
Cost of sick leave due to ILI when the employees are replaced	Number of days out of work × (daily labour costs ^b + daily labour costs ^b of replacement)
Cost of decreased productivity due to ILI episodes	Number of days worked with ILI symptoms × <i>H</i> % of reduced effectiveness × (daily labour costs ^b + daily individual operating income ^b)

a Vaccination time was assumed to be an average of 10 (director, manager) to 15 (train driver, assistant train driver, technical personnel) minutes.

b Individual hourly labour cost and operating income were estimated from Human Resources Department data and based on the average salaries charged to the employer according to the five categories of employee's position identified in the study's questionnaire (technical personnel, manager, assistant train driver, director, train driver).

H = productivity rate when sick; **ILI** = influenza-like illness.

characteristics of the subjects are presented in table II.

Effectiveness of Influenza Vaccination

A total of 194 episodes of ILI were reported by 174 employees over the 8 months of follow-up – 146 cases in unvaccinated individuals and 48 in those who had been vaccinated (table III). The principal symptoms of ILI were fever, coryza and cough, which were more frequent among unvaccinated subjects. The attack rate for ILI was lower among vaccinated subjects (6.8%) than among unvaccinated individuals (23.2%). In the unvaccinated group, 20.5% (129/630) of subjects reported at least one ILI episode, while 6.4% (45/701) of those in the vaccinated group had at least one ILI episode. The number of days with ILI symptoms in the unvaccinated group was more than 3-fold higher than in those who had been vaccinated (1243 days in the unvaccinated cohort of 630 people vs 353 days in vaccinated cohort of 701). Similarly, the total number of working days lost through ILI was significantly higher in the unvaccinated group: 1014 versus

216 (table III). The mean duration of ILI was 2 days longer in unvaccinated subjects than in those vaccinated (*p* < 0.05) and the mean number of days of sick leave was 3 days longer in the unvaccinated group (*p* = 0.002). Vaccine effectiveness against ILI episodes, number of days with ILI symptoms and absenteeism days was therefore 70.4%, 74.4% and 80.8%, respectively (table III).

Individuals taking sick leave were replaced internally by their colleagues; therefore, the RRPC did not pay any external replacement fees. In the unvaccinated group, 1007 of 1014 days (99%) were replaced and in the vaccinated group, 212 of 216 days (98%) were replaced. Employees returning to work before complete recovery or employees who did not take sick leave, resulted in 229 and 137 days of presenteeism with reduced productivity in the unvaccinated and vaccinated groups, respectively.

Vaccination Adverse Effects

There were no reported cases of serious complications associated with influenza vaccination.

Table II. Demographic and baseline characteristics of the vaccinated and unvaccinated subjects

Characteristics	Unvaccinated (n=630)	Vaccinated (n=701)	p-Value
Mean age (y)	39.2	38.6	NS
Sex (%)			NS
female	44.7	50	
male	55.3	50	
Mean number of household members	3.2	3.0	NS
Number of children in household (%)			NS
none	37.2	42	
at least one	62.8	58	
Education level (%)			<0.0001
college	57	47.2	
elementary	0	0.1	
high school	27.8	27	
institute	13.6	25.6	
vocation	1.6	0	
Position (%)			0.002
assistant train driver	11.1	9.3	
director	1.7	5.3	
manager	16.3	18.1	
technical personnel	54.1	47.9	
train driver	16.7	19.4	
Mean health status ^a	8.8	8.6	NS
Smoking status ^b (%)			0.016
smoker	52.7	47.2	
non-smoker	32	39.6	
ex-smoker	15.3	13.2	
Household passive smoking (%)			0.033
yes	61	33.2	
no	39	66.8	
Sick leave in past 6 months (%)			NS
yes	26.8	27.9	
no	73.2	72.1	
Previous influenza vaccination (%)			<0.0001
yes	64.3	81.1	
no	35.7	18.9	
Household influenza vaccination planned ^c (%)			<0.0001
yes	16.2	54.4	
no	83.8	45.6	

a Health status was assessed using a horizontal scale graduated from 0 to 10 and the following question "Overall, how would you rate your health? Please circle one number between 0 (worst possible health) and 10 (normal health for someone your age) which best described your pre-flu health."

b Smoking status was assessed with the question "Do you or have you ever smoked?"

c Planned household influenza vaccination was assessed with the question "Does anybody in your household plan to be vaccinated against influenza this year?"

NS=no significant difference if $p > 0.05$.

Table III. Influenza-like illness (ILI) episodes, sick leave and vaccine effectiveness

	Unvaccinated (n=630)	Vaccinated (n=701)	All (n=1331)	Vaccine effectiveness (%)
Total no. of ILI events	146	48	194	70.4
Total no. of days with ILI symptoms	1243	353	1596	74.4
Days with ILI symptoms per person (mean ± SD)	9.64 ± 4.49	7.84 ± 3.50	9.17 ± 4.32	
Total no. of sick leave days (absenteeism)	1014	216	1230	80.8
Sick leave days per person (mean ± SD)	7.86 ± 4.95	4.80 ± 5.32	7.07 ± 5.21	

Of the 701 subjects vaccinated, 126 individuals reported adverse effects 1 week post-vaccination, giving an adverse event rate of 18%. The most prevalent local symptoms were pain (6.6%) and redness (3.6%), while the most frequent systemic symptoms were a general feeling of being unwell (4.3%), headache (3.3%), runny nose (3%) and tiredness (2.9%). The majority of subjects with adverse events (82.5%) did not visit any health-care centre for their symptoms, while 15 employees visited the company clinic and five individuals went to a health centre. One employee took sick leave for 5 days after vaccination.

Economic Benefit of Influenza Vaccination

For the employer, the mean cost of ILI episodes per employee in the unvaccinated cohort (total cost of ILI episodes in the unvaccinated cohort divided by the number of employees in this cohort) if an employee who continues to work when experiencing ILI symptoms has a productivity rate of 70%, 50% and 30% was €11.91, €15.44 and €18.97, respectively (table IV). These costs were significantly different from the mean ILI episode costs per employee in the case of vaccination for the three productivity rates ($p < 0.05$). Indeed, the total ILI costs of this cohort were

lower due to the reduction in the number of episodes. Costs avoided as a result of vaccination were €10.82 for a 30% productivity rate, €9.17 for a 50% rate and €7.52 for a 70% rate.

The majority of the costs of the vaccination programme were those linked to purchasing the vaccine and materials needed for its administration, such as cotton and alcohol (€4.9). Costs linked to the time required to perform vaccinations (3 minutes for the physician, 2 minutes for the nurse and 4 minutes for the administrative department) and the loss of working time for vaccinated subjects (10–15 minutes per person depending on their function) were limited but included in the calculations. Total vaccination cost to RRPC was €3774, i.e. €5.39 per vaccinated employee. Figure 1 shows that, for each reduced productivity rate, the mean cost of vaccination and ILI per vaccinated employee was less than the mean cost of ILI per unvaccinated subject, i.e. the vaccination programme was cost saving to RRPC. The annual cost savings per vaccinated employee ranged from €2.13 to €5.43 depending on the productivity rate while sick. At the RRPC level, considering, for example, a 50% influenza vaccine coverage rate with 1 122 367 employees, the yearly global cost savings would be between €1.2 million and €3 million.

Table IV. Cost of influenza-like illness (ILI) episodes (€, May 2006 rate) and costs avoided due to vaccination per employee according to productivity rate if working while sick

	Unvaccinated		Vaccinated		Mean cost avoided with vaccination
	mean cost of ILI episodes	SD	mean cost of ILI episodes	SD	
$H = 30\%$	18.97	50.08	8.15	38.44	10.82
$H = 50\%$	15.44	42.10	6.27	28.61	9.17
$H = 70\%$	11.91	31.37	4.39	19.50	7.52

H = productivity rate when sick.

Fig. 1. Cost of influenza-like illness (ILI) episodes and vaccination per employee for three levels of productivity rates with ILI (H1 = 70%; H2 = 50%; H3 = 30%). ¹ Due to ILI symptoms, the vaccine's adverse effects and time lost to receive the vaccine.

Additional Analyses

Six of the subjects' personal characteristics (i.e. education level, employee position, smoking status, passive smoking, previous influenza vaccination and household influenza vaccination planned) were statistically different between the vaccinated and unvaccinated groups at baseline. Multivariate analyses performed showed that these confounders had no significant effect on the occurrence of influenza or on the economic results (see the Supplemental Digital Content for detailed results). Similarly, neither age nor occupational group individually was found to have a significant effect on the occurrence of influenza or the associated costs.

Discussion

Absenteeism and the reduced productivity of sick workers have direct financial consequences on a company. This cost analysis and vaccine-effectiveness study demonstrated that an influenza vaccination programme significantly reduced ILI episodes and absenteeism, and that vaccination had a positive return on investment, even for a

conservative scenario of presenteeism with a 30% reduced productivity rate. If we considered that 40% of RRPC employees had been immunized in 2008 (RRPC had purchased 500 000 doses in 2008 for 1 300 000 employees), the cost saving by RRPC would have been between €1 million and €2.7 million that year. In addition, as the influenza epidemic during the 2005–6 season was mild, with low rates of infection, vaccination during seasons with higher attack rates, such as those from 1969 to 1983, with a 21% higher incidence rate, can be expected to bring greater cost savings.^[20]

This study demonstrated that the vaccine was very effective during a mild outbreak of influenza virus, and there was a good match between the strain of vaccine and the circulating viral strains. However, as the epidemiology of each influenza season differs, it cannot be assumed that the same results would be achieved each year. The efficacy and safety of the vaccine has been established previously using laboratory-confirmed cases of influenza, including some clinical trials performed in Russia.^[21–23] The present study supports these efficacy and safety data. In addition, the data confirm the results of other studies that showed that influenza vaccination can be cost saving in most corporate settings, as well as producing significant health-related and economic benefits to the employees.^[13,24–28] In the randomized placebo-controlled trial reported by Bridges et al.,^[13] influenza vaccination of healthy working adults aged <65 years significantly reduced the rates of ILI, sick leave days and physician visits when the vaccine and circulating influenza viruses were similar. From the societal perspective, a cost-benefit analysis of direct and indirect costs associated with influenza vaccination of healthy working adults and costs prevented by vaccination found that immunization was cost saving and supported a strategy of routine annual vaccination.^[26] A prospective randomized trial conducted in Australia during the 2000 influenza season demonstrated that influenza vaccination programmes in an occupational setting may represent a cost-effective intervention from the employer's perspective, even when influenza activity is considered low in the community.^[29]

This prospective observational study investigated the implementation of a real-life vaccina-

tion programme in a Russian workplace. The confirmation of influenza virus infection by a laboratory was not considered to be practical. As a result, reporting of ILI according to pre-defined symptomatic criteria was used, which has been a common endpoint in other studies. This means that the ILI symptoms cannot be confirmed as necessarily being due to influenza virus infection. Jefferson et al.^[21] found that the positive effect of an influenza vaccination programme would be diminished when the definition of illness was imprecise. Nevertheless, in this study, there were marked differences between the attack rate for ILI and duration of ILI in the vaccinated and unvaccinated groups. In addition, the inclusion of fever in the definition of ILI substantially increased the specificity of the clinical diagnosis.^[30,31]

The study relied upon the active participation of the volunteers and the company medical centre. Although it reflects the current conditions of vaccination by RRPC, the recruitment method of volunteers is one of the limits of the study as the vaccinated population may have a more favourable opinion of vaccination than the general population. Another limitation inherent to observational studies was the potential lack of identification of all confounding factors. Several of the subject characteristics differed at baseline between the vaccinated and unvaccinated groups. These included education level, employee position, smoking status and previous vaccination status. Although use of multivariate regression models did not detect any confounding effect of these personal characteristics on the clinical and economic outcomes of this study, they might not have detected the entirety of the potential confounding effects of the variables. In addition, some other potential confounding factors such as concomitant treatment, co-circulation of respiratory viruses, or subjects' body mass index were not collected through the questionnaire and, therefore, could not be included as potential confounders in the multivariate and univariate analyses.

While care was taken to word the questionnaires so that the lay public could easily understand them, some misreporting may have occurred and the reliability of the data may have been undermined. Since the questionnaires were returned

at regular time intervals, it was unlikely that participants would have had difficulty recalling information related to symptoms and sick leave. The report of absenteeism days came from the employee's declaration and a comparison with Human Resources Department data would have increased the robustness of the data. Data management observed two outlier values in the number of sick leave days taken due to ILI symptoms for one unvaccinated and one vaccinated subject (17 and 18 days, respectively). Since these values were similar, they were excluded from the data set, although they may have influenced the results.

Employees' influenza vaccination rates are quite low in Russia as in most other countries.^[18] Barriers to influenza vaccination are usually linked to a low level of fear of contracting influenza, suspicion of the effectiveness of influenza vaccination, or because previously people had never considered being vaccinated,^[32] particularly in the healthy adult population. In Russia, constraints to vaccination of employees are also linked to the necessity of performing the vaccination in a particular medical setting, and to contract a healthcare professional to administer the vaccine. Few companies have such facilities in place. Employees' access to vaccination against influenza can be leveraged through internal promotion of the benefits of implementing such an immunization programme. The coverage rate can also be optimized if the company decides to allocate funds to vaccine supply, which is the case for RRPC since it routinely offers influenza vaccination.

Finally, the workplace, with its confined spaces and production sites, provides the perfect opportunity for the rapid spread of influenza virus. For example, it has been reported that a single passenger with symptoms of influenza would spread the infection to 72% of people aboard a commercial airliner.^[33] In addition, an outbreak of influenza A infection aboard a cruise ship affected 48% of the travellers within 2 days of exposure.^[34] It has been estimated that influenza transmission can be significantly reduced through 'herd immunity' by vaccinating 75% of the total population against influenza virus.^[35,36]

Conclusions

Vaccination with trivalent inactivated influenza vaccine has demonstrated effectiveness in reducing the incidence of ILI by 70.4%, with a related 80.8% reduction in absenteeism, and with a 74.4% reduction in total days with ILI. From the RRPC employer perspective, the return on investment in the employee's influenza vaccination was shown to be positive, even for a conservative scenario of presenteeism. This vaccination programme should be considered in other large Russian corporate settings.

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