MODERN KNOWLEDGE ABOUT INFLUENZA – A REVIEW OF NATIONAL AND WORLD LITERATURE

WSPÓŁCZESNA WIEDZA NA TEMAT GRYPY – PRZEGLĄD KRAJOWEGO I ŚWIATOWEGO PIŚMIENNICTWA

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ABSTRACT

Influenza, as a contagious and common disease, is a continuing current problem and a threat to human health and life. According to the WHO, up to 1.5 billion people suffer from flu and even 1 million people die of influenza each year.
Preventive vaccination is the most effective method for the prevention of influenza. According to the WHO recommendations, the largest possible proportion of the global population should be covered by the vaccination programme. In particular, people from high-risk groups and young children should receive vaccination. New vaccines against influenza appear at the turn of September and October, and it is the best time to get vaccinated. In Poland, however, the peak incidence of influenza falls between January and March, and therefore it is possible to be vaccinated at a later date. In the past two years, the incidence of flu in Poland nearly doubled, and the number of hospitalizations increased by almost half. The number of vaccinations in Poland has decreased almost three times over the last ten years. Timely data indicate that only 5% of the population get vaccinated against influenza. It should also be emphasized that in Poland the influenza-related costs, that is an underestimated problem, range between 40 and 700 million zloty per year.

KEYWORDS: influenza, the influenza epidemiology, complications of influenza, vaccination.

STRESZCZENIE

Grypa jako choroba zakaźna występująca powszechnie stanowi niezmiennie aktualny problem i zagrożenie dla zdrowia i życia. Zgodnie z danymi WHO każdego roku na grypę choruje do 1,5 miliarda osób, a w wyniku tej choroby umiera nawet 1 milion populacji.
Najskuteczniejszą metodę zapobiegania grypie stanowią szczepienia ochronne. Według zaleceń WHO szczepieniem powinien być objęty jak największy odsetek światowej populacji. Szczepieniom powinny poddać się przede wszystkim osoby z grup wysokiego ryzyka oraz małe dzieci. Nowe szczepionki przeciwko grypie pojawiają się na przełomie września i października, i to w tym okresie powinno się zaszczepić. W Polsce jednak szczyt zachorowań na grypę przypada między styczniem a marcem, w związku z czym można dokonać szczepienia w późniejszym terminie. W ciągu ostatnich dwóch lat zapadalność na grypę w Polsce wzrosła prawie dwukrotnie, a liczba hospitalizacji wzrosła prawie o połowę. Liczba szczepień w Polsce na przestrzeni ostatnich dziesięciu lat spadła prawie trzykrotnie. Aktualne dane podają, że jedynie 5% społeczeństwa szczepi się przeciwko grypie. Warto też podkreślić, że koszty spowodowane przez niedocenianą grypę w Polsce sięgają od 40 do ponad 700 milionów złotych rocznie.

SŁOWA KLUCZOWE: grypa, epidemiologia, powikłania, szczepienia ochronne.

Introduction

Influenza is an infectious, acute respiratory disease. It constitutes a group of clinical symptoms associated with the acute respiratory infection caused by an influenza virus. Influenza is caused by influenza A and B viruses that comprise one genus, and type C virus that is substantially different from A and B viruses. They all belong to the family Orthomyxoviridae [1, 2, 3].

The disease process may involve the upper and lower respiratory tract. The course of influenza is associated with the occurrence of general symptoms, such as fever, muscle pain, headache, and general weakness. Influenza epidemics covering various areas and having different severity are observed almost every winter. An epidemic results in an increasing mortality rate among high-risk patients [1, 2, 3].

Influenza Epidemiology

An infected person, regardless of age, constitutes the most common source of infection. A local outbreak occurs usually every one to three years and global epidemics and pandemics occur every ten to fifteen years [1]. Zoonoses are also possible. They are caused by animal viruses. Influenza is spread through the air or by a direct contact with objects that are contaminated with respiratory secretions from an infected person [2, 3].

There are seasonal influenza and pandemic influenza. Seasonal influenza occurs on a yearly basis in the epidemic season. It is caused by common human influenza viruses. Pandemic influenza occurs every several years or decades and is caused by yet unknown subtypes or variants of influenza viruses. During a pandemic, new infections spread very fast, since a majority of the human population has not developed immunity against new types of viruses. Therefore, the number of new cases during a pandemic exceeds several times the number of new cases during common annual epidemics. Declaration of a pandemic depends on the decision by the WHO. It is geographical coverage that matters here, not the severity of incidence [1, 2, 3].

Epidemics of influenza occur every year but their severity and coverage differ. Global pandemics are observed significantly less often than local epidemics. The most severe epidemics covering the largest areas are caused by influenza A virus, the most active one [1, 2, 3].

Influenza B virus usually causes less severe epidemics covering smaller areas compared to influenza A virus. They usually occur in military camps and schools as well as in elderly care homes. In comparison with influenza A and B viruses, influenza C virus less commonly cause disease in humans. Influenza C virus is commonly associated with asymptomatic infections and occasional, mild diseases and does not cause epidemics [1, 2, 3].

Increased incidence and mortality constitute a serious problem resulting from flu epidemics. Most influenza-related deaths are associated with the presence of other previous illnesses that increases the risk of complications. Factors increasing the risk of death mainly include old age and chronic respiratory and heart diseases. A slightly lower mortality rate than in the above cases is observed in patients with chronic renal diseases, metabolic diseases and certain diseases that affect the immune system [1, 2, 3].

At present, factors responsible for the outbreak and the ending of an epidemic are not fully known. The immunity level of persons who are in danger of being infected constitutes the main criterion that decides about the severity and geographic spread of an epidemic. An outbreak may be caused by an antigenically new virus among a given population. Antibody response to such a virus is low or absent. If the absence of the corresponding antibodies occurs all around the world, a pandemic is likely to develop. A pandemic wave may last for several years until high population immunity is developed [1, 2, 3].

The most lethal outbreak in history was the 1918-1919 flu pandemic in Europe. Approximately 50 million people died of the Spanish flu pandemic, i.e. about five times more than during the entire World War I [4].

Global epidemiological and virological situation of influenza

Influenza occurs worldwide. In the temperate climate zone, an increase in the number of flu cases is observed commonly in the autumn/winter season [2]. The flu season in the Northern Hemisphere occurs between autumn and early spring, whereas in the Southern Hemisphere it falls between spring and late summer [1, 2, 3]. According to the WHO, between 330 million and 1,575 million people become infected and as many as 0,5–1 million people die every year due to influenza and influenza-like infections [3].

Seasonal influenza is most commonly caused by type A Influenza, subtypes H1N1 and H3N2, and also by H1N2 in some seasons, but rarely by type B Influenza. Over the past years, there were reported several cases of influenza in humans caused by avian influenza virus that may possibly cause a pandemic and carry a high risk of complications and high mortality rate. They were mostly observed in Asia and Egypt (H5N1) and China (H7N9). However, human-to-human spread of avian influenza is limited [1, 2, 3].

In March 2009 a number of flu cases caused by a new type of influenza A/ H1N1 virus was observed in Mexico. Another foci of influenza were found worldwide, which made the World Health Organisation declare a pandemic in June 2009 [5]. The new type of influenza A/H1N1 prevailed in 2009/2010 season. It was also present during consecutive seasons, but was less common [1, 2, 3]. The 2009 H1N1 influenza virus emerged as a result of reassortment between Eurasian and North American pig flu viruses. Severe infections were observed mostly in young children and pregnant women, persons with other diseases, and young adults [5]. Information on pandemic flu is collected and updated by Centers for Disease Control and Prevention (CDC) and World Health Organisation (WHO) [6].

Epidemiological and virological situation of influenza in Poland

In Poland, because of the temperate climate, influenza occurs seasonally during the autumn/winter period every year [7]. The number of flu cases and hospital admissions for influenza are reported in Poland to the Local Sanitary and Epidemiological Stations. Then data in the form of reports are sent every week or two weeks by the Voivodship Sanitary and Epidemiological Stations to the National Institute of Hygiene. Data about influenza-related deaths are annually processed by the Central Statistical Office [8]. During the 2014/2015 influenza season, over 3.7 million cases of influenza and suspected influenza were reported in Poland. There were also as many as 12,200 hospital admissions and 11 deaths caused by the infection. This constituted a 37% increase in infections and nearly 50% increase in hospital admissions compared to the 2013/2014 season. The influenza vaccination coverage rate in Poland for the last three years has remained low, amounting to approximately 3.7% of the population [1, 2, 3]. See **Table 1** for cases of influenza and suspected influenza as well as related hospitalisations and deaths in Poland.

Table 1. Data on cases and suspected cases of influenza and related numbers of hospitalizations and deaths in the seasons 2006/2007–2014/2015

Season	Morbidity	Hospitalization	Deaths
2006/2007	355 326	730	0
2007/2008	243 591	142	0
2008/2009	562 443	2 200	0
2009/2010	855 127	7 949	177
2010/2011	1 061 391	5 470	187
2011/2012	1 066 238	3 289	1
2012/2013	2 989 041	13 837	119
2013/2014	2 761 522	9 374	15
2014/2015	3 774 795	12 227	11

Source: Recommendations of Polish experts on prevention of influenza during influenza season 2015/2016 Open Letter to experts. Practical Medicine, Krakow 2015

A comparison of the number of flue cases registered before the 2009 influenza pandemic and during the post-pandemic period demonstrated an increase in the incidence of influenza and influenza-like diseases. The recent increase in the number of influenza cases reported is a result of the improvement of the quality of the surveillance system introduced during the 2009 flu pandemic. The case definition expending the scope of registration and the increase in frequency of reports about new cases were introduced. They helped to increase the system sensitivity, and thus the number of cases registered [9].

The number of vaccinations reported to the National Institute of Public Health – the National Institute of Hygiene (NIZP-PZH) shows a downward trend. The vaccination rate in Poland is too low to significantly slow down the virus circulation among the population. See **Table 2** for the number of influenza vaccinations registered in Poland.

Table 2. The number of influenza vaccinations reported to the NIPH-PZH

Year	Immunization
2006	1 371 605
2007	1 212 651
2008	1 158 878
2009	1 577 332
2010	1 168 432
2011	1 061 111
2012	903 308
2013	928 706
2014	855 085

Source: Recommendations of Polish experts on prevention of influenza during the influenza season 2015/2016 Open Letter to experts. Practical Medicine, Krakow 2015

A comparison between the number of registered influenza vaccinations and the number of influenza vaccines sold on the market demonstrated that approximately 40–45% of vaccines administered most probably in private doctor's offices and medical centres are not reported to the NIZP-PZH [9]. See **Table 3** for the number of administered influenza vaccinations.

Table 3. Estimation of the number of vaccinations carried out based on the number of units sold on the Polish market of influenza vaccines, and the number of administered vaccinations reported to the NIPH-PZH in different age groups

Year	Immunization
2006	2 930 656
2007	2 339 300
2008	2 164 783
2009	2 593 707
2010	1 990 507
2011	1 728 000
2012	1 411 000
2013	1 422 000
2014	1 424 000

Source: Recommendations of Polish experts on prevention of influenza during the influenza season 2015/2016 Open Letter to experts. Practical Medicine, Krakow 2015

Pathogenesis of influenza virus infections

The initial stage of the disease begins when the respiratory epithelium becomes infected with the influenza virus. Aerosols from sneezing and coughing play a dominant role in transmission of the disease [4].

Influenza virus replicates in epithelial cells of the upper and lower respiratory tract. The extrapulmonary

replication of the avian influenza H5N1 virus constitutes the only known exception. Influenza virus does not cause viremia. General symptoms of the infection are caused by cytokines released during an inflammatory reaction. It was found that the 2009 H1N1 influenza virus had a higher affinity for the epithelial cells of the lower respiratory tract compared to other seasonal flu viruses [1, 2, 3].

The replication cycle of influenza virus in infected cells lasts between four and six hours. Then infectious viral particles are released to involve nearby cells. The severity of the disease is associated with the amount of the virus excreted from the respiratory tract [4]. The influenza incubation period amounts to about 1–7 days, 2 days on average. An infected person excretes virus from 1-6 days before the onset of symptoms up to a week after symptoms have subsided [1, 2, 3].

Humans as well as a number of animals constitutes the reservoir of influenza viruses. The disease is spread mainly through the air but it is also possible to transmit the infection by a direct contact with contaminated objects or hands [1, 2, 3].

Risk factors include a direct contact with an infected or ill person as well as contaminated objects, face-to-face contact, longer stay near a person with influenza without any protection (e.g. a protective mask), being in huge crowds during flu seasons, insufficient hand hygiene, as well as touching eyes, nose and mouth with contaminated hands [1, 2, 3].

Clinical picture of influenza

A sudden outbreak of general symptoms, such as a headache, muscle pain, fever, chills, general weakness, as well as accompanying respiratory-related symptoms, such as cough and sore throat commonly occur in the course of influenza. Fever ranges between 38 and 41°C in most cases [4].

A sudden temperature rise occurs during the first 24 hours and then it drops gradually for the following 2-3 days but fever may persist up to a week. Patients usually give a history of a feeling of cold and fever. A headache in the frontal region or generalized headache may be particularly inconvenient. Muscle pain may affect any part of the body. They mostly occur in the lumbosacral region and in the lower extremities. Joint pain may also appear. With the resolutions of general symptoms, respiratory-related complaints start to prevail. A number of patients develops persistent cough and sore throat [4].

The range of the clinical course of the disease may be very wide. In some cases there is a mild respiratory disease without fever and respiratory-related symptoms may be slight [4].

In children, the aforementioned symptoms may be accompanied by nausea, vomiting, and diarrhoea [1, 2, 3]. In the elderly, influenza may be accompanied by confusion, loss of appetite, fatigue, and lack of fever [7].

Uncomplicated influenza

In uncomplicated influenza acute symptoms usually resolve within 2–5 days. Patients fully recover within a week [4]. Cough is a symptom that lasts the longest, even up to two weeks. In not numerous patients, particularly in elderly persons and in persons with chronic diseases, general weakness and fatigue may last up to several weeks [6].

Complications of influenza

Complications of influenza occur mainly in persons aged over 64 as well as in patients with chronic diseases, such as diabetes mellitus, heart diseases, pulmonary diseases, renal impairment, haemoglobinopathy, conditions of immunosuppression. Children under 2 and pregnant women during the second and third trimesters are also particularly susceptible to complications [4].

Pneumonia is the most serious and most common complication of influenza. Primary influenza viral pneumonia, secondary bacterial pneumonia, or mixed viral and bacterial pneumonia may develop as a result of infection with influenza [4]. Primary pneumonia is one of the least common but also most serious flu complications. Its clinical symptoms include: exacerbation and no resolution of acute flu symptoms, acommpanied by persistent dyspnoea, fever, and possible cyanosis. Persons with heart diseases and pregnant women are predisposed to develop primary pneumonia [4]. Secondary bacterial pneumonia is a consequence of the acute stage of influenza. It occurs after 2–3 days following the improvement of the patient's general condition. Fever and clinical symptoms of bacterial pneumonia such as cough and purulent secretion as well as pulmonary densities are developed. Secondary pneumonia is most often caused by the following pathogens: Staphylococcus aureus, Streptococcus pneumoniae, and Haemophilus influenzae. This complication most often occurs in older persons and patients with chronic cardiovascular and respiratory diseases [4].

The most common pulmonary complications during flu epidemics probably have characteristics of both primary and secondary pneumonia. This is pneumonia of mixed aetiology, in which symptoms of the acute primary disease gradually worsen or clinical symptoms exacerbate and symptoms typical of bacterial pneumonia develop. This complication occurs mainly in persons with chronic cardiovascular and respiratory diseases [4]. Other pulmonary complications include: exacerba-

tion of chronic respiratory diseases such as chronic obstructive pulmonary disease (COPD), chronic bronchitis, and asthma [4].

The remaining post-influenza complications with an extrapulmonary site of infection are rare. Reye syndrome is developed very rarely, usually in children, constituting a serious complication of influenza A or B, or infection with varicella-zoster virus. Reye syndrome is usually associated with the use of acetylsalicylic acid [1, 2, 3]. The following complications are observed particularly in children: gastrointestinal conditions, abdominal pain, nausea, vomiting, and diarrhoea. An increased number of cases of myositis and otitis media is also observed in children 10].

Except for complications related to particular systems and organs, in at-risk groups and elderly persons influenza may lead to a gradual exacerbation of coexisting chronic diseases. In some cases changes may be irreversible and lead to death. This contributes to the increased mortality during influenza epidemic [1, 2, 3].

Diagnosis of influenza

During an epidemic season when the activity of influenza viruses in a particular area is confirmed, the diagnosis is usually clinical. Studies conducted among adults in good general health demonstrated that a clinical diagnosis is correct in 80–90% of patients. However, clinical diagnosis rates are much lower among the elderly and paediatric patients [10].

The following data can make a clinical diagnosis easier: medical history indicating a contact with a person infected with influenza, epidemiological information about an increased incidence of influenza, and results of epidemiological follow-ups indicating an increase in the number of patients presenting with particular symptoms [6].

Communicable diseases with similar signs and symptoms need to be considered in differential diagnosis of influenza. They include diseases caused by adenoviruses, RSV, rhinoviruses, Legionella sp., and Mycoplasma pneumoniae [10].

A positive virological test confirms diagnosis of influenza. Virological examinations include, among others, direct (DFA) or indirect (IFA) immunofluorescence, detection of the virus genetic material using the RT-PCR, virus isolation in cell culture, as well as the rapid antigen test of samples taken from the nose and throat (washings, aspirate, and swab). The time to obtain results depends on the method used for examination. The waiting time in the case of immunofluorescence is about 1-4 hours, in the case of RT-PCR it is 1-6 hours, in the case of cell culture it is between 3 and 10 days, and in the case of the rapid antigen test it is up to 30 minutes [1, 2, 3].

RT-PCR constitutes the most precise technique used in the diagnosis of influenza. Specimens need to be taken with the use of a swab entirely made of plastic. A number of factors influences test results: sample collecting method and type of sample collected, time of sample collection since the onset of the disease, transport and storage conditions. Any problems may produce false-negative results. Aspirates from the trachea and bronchi need to be tested in the case of the involvement of the lower respiratory tract. In Poland, RT-PCR is performed in laboratories of selected voivodship sanitary and epidemiological stations and in the National Institute of Hygiene [1, 2, 3].

Rapid tests for detection of the influenza virus antigen constitute another technique for diagnosing influenza. Rapid antigen tests have high specificity (80–100%) but moderate sensitivity (10–80%). Therefore, with a negative result, infection cannot be ruled out when the clinical presentation and epidemiological data are suggestive of influenza [1, 2, 3]. An advantage of rapid antigen tests is that the results are obtained within 30 minutes. In Poland, the usefulness of rapid tests is limited due to their high costs and moderate risk (up to 30%) of false-positive or false-negative results [6].

Although virological examinations are not necessary in most cases, they need to be considered in high risk groups and in persons with severe or progressive influenza-like infections and other indications for hospitalisation [1, 2, 3].

A severe case of influenza or its complications, being an indication for hospitalisation, is diagnosed if, except for the initial typical symptoms, at least one of the following occurs:

- central nervous system related symptoms (convulsions, encephalopathy, encephalitis), severe dehydration, clinical (hypoxia, tachypnoea and other dyspnoea symptoms) and/or radiological (signs of pneumonia) symptoms of the lower respiratory tract infections,
- secondary complications such as sepsis, septic shock, renal failure, multiple organ insufficiency, skeletal muscle disintegration, myocarditis,
- exacerbation of chronic primary disease, e.g. COPD, asthma, chronic failure of the liver, heart and kidneys, coronary heart disease, and diabetes mellitus,
- other indications for hospitalisation,
- any sign of progression of the disease [1, 2, 3].

Development of alarming symptoms in patients reporting to a doctor due to uncomplicated influenza

indicates a progression (exacerbation) of the disease. The patient's condition may deteriorate very fast and the presence of alarming symptoms is an indication for quick verifications of treatment methods and hospitalisation in most cases. The alarming symptoms include:

- signs and symptoms of the involvement of the lower respiratory tract or heart insufficiency (chest pain, heamoptysis, low blood pressure, decreased oxygen-haemoglobin saturation by pulse oximetry, dyspnoea, and cyanosis),
- symptoms indicating complications related to the central nervous system (disturbance of consciousness, pathological somnolence, loss of consciousness, seizures, paralysis, paresis, and deterioration of muscle functions),
- symptoms indicating severe dehydration (decreased diuresis, dizziness, pathological somnolence, syncope upon standing up, other consciousness disorders),
- clinical or laboratory symptoms of the present viral infection or invasive secondary bacterial infection (e.g. high fever persisting longer than 3 days) [1, 2, 3].

Treatment of influenza

Uncomplicated influenza generally resolves spontaneously. It usually requires symptomatic treatment and a relatively long convalescence. Symptomatic treatment includes correction of water and electrolyte imbalance, bed rest, antipyretics, antitussives, and light diet. The use of acetylsalicylic acid is contraindicated in children due to the risk of Reye syndrome [10]. Commonly used medicines such as rutoside and vitamin C are not effective in the treatment of influenza and beneficial effects of homoeopathic drugs are not confirmed.

Treatment of complicated influenza depends on the complication itself. A complete anti-shock treatment is recommended in patients with shock. Patients with cardiovascular and neurological complications need a targeted therapy, e.g. cardiovascular, dehydrating, and antioedematous drugs. Antibiotics are used for bacterial pneumonia. However, influenza uncomplicated by bacterial infection does not require antibiotic therapy or antibiotic cover [1, 2, 3].

Specific treatment for influenza consists in administering chemotherapeutic agents to inhibit the replication of the influenza virus. This therapy is recommended for high risk patients. The following agents are used:

- amantadine and rimantadine effective against the influenza A virus,
- zanamivir and oseltamivir effective against influenza A and B viruses
- ribavirin (in vitro active, clinically ineffective) [1, 2, 3].

Since the rate of resistance of the influenza A/H3N2 virus isolate to amantadine was more than 90% over the period 2005-2006, at present it is not recommended to use amantadine and rimantadine on a large scale. However, the use of these drugs might be considered after first determining the sensitivity of a particular influenza viral strain [4].

Legal aspects of treatment and prevention of influenza

The Act of December 5, 2008 on preventing and combating infections and infectious diseases among people is the fundamental Polish act referring to communicable diseases. The Act was published in the Journal of Laws on December 30, 2008 and took effect from January 1, 2009. All people staying in the territory of the Republic of Poland are subject to this law [1, 2, 3].

Legal provisions on preventing and combating infections and infectious diseases among people include, among others, influenza and avian influenza in humans [11]. The Act refers to the rules governing the organisation and control of infections and infectious diseases, organisation of preventive vaccination, procedure for suspected and confirmed cases of infection, contagious disease or death due to communicable disease, monitoring of the epidemiological situation, the procedure in the event of an epidemic or threat of an epidemic, and others [1, 2, 3].

On the basis of Article 34 (1) (2) of the Act on preventing and combating infections and infectious diseases (Journal of Laws, Dz. U. 2008, No. 234, Item 1570), patients with confirmed or suspected H5 or H7 avian influenza have to be hospitalised [11].

Prevention of influenza

Prevention of influenza includes specific methods such as protective vaccination and chemoprevention as well as non-specific methods. Since vaccination against influenza does not provide total protection from being affected, it is advisable to combine different methods [1, 2, 3].

Non-specific methods for preventing influenza include, among others, the use of protective gloves, glasses, apron, and face mask, strict hand hygiene, avoiding mass gatherings and crowds in the epidemic season. Patients need to be isolated for a week since the onset of symptoms and when the symptoms persist for more than 24 hours after acute respiratory symptoms and fever have disappeared. Longer isolation is needed in the case of a patient with immunodeficiency [1, 2, 3].

Systematic prophylaxis, including flu vaccines in particular, helps to reduce the incidence of influenza, mortality due to complications of influenza, potential social and economic impact of the disease as well as ensuring a better functioning of the healthcare system during an epidemic [6].

Preventive vaccination

Preventive vaccination is the most effective method for the prevention of influenza. As the influenza virus exhibits a high mutation rate, the vaccine composition must be updated and vaccines need to be repeated annually [6].

Flu vaccines available worldwide and recommended by the Advisory Committee on Immunization Practices (ACIP) are live or inactivated. The most common inactivated vaccines include split and subunit vaccines. Split vaccines contain a split virion and subunit vaccines contain peripheral membrane proteins. These types of vaccines cannot cause influenza and are recommended for persons of any age over six months of age. The vaccine composition may vary depending on the geographical region [3].

Both split and subunit influenza vaccines are used in Poland. They must be certified by the Polish Ministry of Health [6].

Preventive vaccination should be provided particularly to high risk groups. According to the Center for Disease Control and Prevention (CDC) in Atlanta, such patients constitute approximately 30% of each population. Inactivated vaccines against influenza reduce morbidity and mortality rates among high risk groups by 50-70%. According to the WHO recommendations, the largest possible proportion of the global population should be covered by the vaccination programme. Significant benefits in the efficiency and effectiveness of inactivated vaccines were found in all age groups. Community immunity can be gained with the immunization coverage of about 70–80% of the population [3].

Influenza vaccination is particularly recommended for the elderly. The risk of influenza in persons over 65 years of age increases tenfold. Most influenza-related complications and deaths concern older people [3].

Flu vaccines among patients with diabetes mellitus reduce the mortality rates by 56% and the number of hospital admissions by 70%. Diagnosis of diabetes mellitus is an indication and not a contraindication to immunisation. Compared to non-diabetics, the risk of hospitalisation of a diabetic is six times higher and mortality rate is two-three times higher. During an epidemic the risk of death increases by 5–15% among patients with diabetes mellitus. The WHO, the American Diabetes Association, and the Polish Diabetes Association recommend annual vaccination as safe and effective [7].

Vaccination against influenza is also important for persons with heart diseases as it has been observed that the number of myocardial infarctions and cardiovascular-related deaths increases during influenza epidemics. It was found that 25% of myocardial infarctions is preceded by an acute respiratory infection. Influenza vaccination in patients with coronary heart disease reduces the risk of serious cardiovascular events by approximately 30% as well as the risk of hospitalisation and death. Immunisation is recommended to patients with chronic heart insufficiency since it decreases the risk of viral myocarditis and pericarditis. Numerous societies of cardiology recommend flu vaccination in all persons with heart and circulatory diseases [12].

Owing to the fact that the risk of hospitalisation due to complications of influenza in pregnant women is sevenfold higher than in general population, protective vaccination is particularly recommended for this group. Over half of flu complications occur in pregnant women during the second and third trimesters. In vaccinated pregnant women, the number of febrile infections in mothers was reduced by 36% and the number of laboratory confirmed influenza in children decreased by 63%. 92% efficacy of vaccination against influenza in pregnant women was observed in prevention of hospitalisation for influenza in newborns and infants below 12 months of age. Immunisation of women during pregnancy and the puerperium period helps to protect babies who cannot be vaccinated due to medical contraindications or their young age. It was not found that influenza vaccination increases the risk of C-section, premature birth, miscarriage, or has a harmful effect on foetal development and the incidence of psychomotor difficulties and malformation in children at later stages of life [7].

Vaccinations are recommended for children from the age of 6 months. According to the WHO, children between 6 months and 2 years of age should be vaccinated in the first place since the youngest children are at high risk for complications of influenza. In Poland, children aged between 2–5 years receive the seasonal influenza vaccine most often whereas infants receive it least often. A well-matched vaccine gives 50–80% vaccination efficacy in children. Vaccinations against influenza in children are safe and post vaccination reactions are usually local. General adverse events occur in children who receive their flu vaccine for the first time. Immunisation of children helps to reduce the spread of flu to other age groups as well [13]. It was observed that vaccination of schoolchildren reduces the incidence of influenza among all age groups [3].

Chemoprevention of influenza

Chemoprevention of influenza consists of using antiviral drugs effective against influenza viruses. Efficacy of up to 84–89% was observed in the prevention of influenza A and B viruses following the use of inhaled zanamivir with a dose of 10 mg per day or orally administered oseltamivir with a dose of 75 mg per day. The prophylactic use of amantadine and rimantadine is not recommended since the growing resistance of influenza viruses to these therapies has been reported [4]. Chemoprevention should be initiated up to two days since the onset of symptoms and continued for at least five days. It is estimated that the efficacy of chemoprevention reaches 50% in reduction of the risk of pneumonia [1, 2, 3].

Chemoprevention should be applied to high risk patients who have not received a flu vaccine as well as when a vaccine provided might be ineffective due to an antigenic change of the virus. During an influenza epidemic, chemoprevention may be used together with an inactivated vaccine, which does not interfere with the immune response to vaccination. It was demonstrated that the use of a live-attenuated vaccine in combination with chemoprevention may interfere with the immune response to vaccination. Chemoprevention should not be introduced for at least two weeks after live-attenuated vaccine. This kind of prophylaxis may be used to control intrahospital influenza epidemics [4].

Surveillance of influenza

In Poland, cases of influenza and influenza-like diseases must be reported to the State Sanitary Inspection. Data from the Voivodship Sanitary and Epidemiological Stations are the basis for reports by the Epidemiology Institute of the National Institute of Hygiene about the current epidemiological situation. At the national level, surveillance of influenza is coordinated by the National Influenza Centre cooperating with the regional and global WHO reference centres [10].

The Department of Influenza Research plays the role of the National Influenza Centre in Poland. Since it is the only institution of that kind in Poland, it is a reference centre for influenza at the national level. The National Influenza Centre cooperates both with the WHO and the European Centre for Disease Prevention and Control (ECDC). It is also a member of international scientific networks, including the European Influenza Surveillance Network (EISN) and the Global Influenza Surveillance and Response System (GISRS). The tasks of the National Influenza Centre include: to perform virological surveillance of influenza, to perform antigenic analysis of the influenza strains, to coordinate, at the national level, the influenza SENTINEL surveillance system, where the participants are Voivodship Sanitary-Epidemiological Stations and a representative number of family physicians, to perform diagnostics of influenza and influenza-like infections, as well as working in the area of the national preparedness for the influenza pandemic [13].

A well-functioning network for surveillance of influenza makes it possible to monitor the worldwide epidemiological situation and track the antigenic change among flu strains. This provides the basis for developing and updating the composition of influenza vaccine for each epidemic season [10].

Socio-economic effects of influenza

Except for serious health implications, influenza infections may also have social and economic effects. Social consequences involve imposing a burden on the healthcare system as well as impeding the occupational and social functioning of patients and their family members taking care of the patient. Economic costs include, among others, occupational absence of patients and their relatives involved in care, costs of medications, as well as inpatient and outpatient costs [6].

According to international data, costs of medical treatment for influenza and sickness absence due to influenza amount to billions of dollars, depending on the epidemic season and country's population. The cost of influenza epidemic in the USA amounts to 71–167 billion dollars depending on an epidemic season. According to a German study of 1996, it costs 632 euros on average to treat a patient with influenza. According to the National Interview Survey, in 1995 influenza infections among working adults in the USA were responsible for over 200 million days of limited activity at work and 75 million days of absence from work [10].

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