Chapter 34

Infections with A(H1N1)2009 Influenza Virus in Poland During the Last Pandemic: Experience of the National Influenza Center

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Abstract This study presents epidemiological and clinical data on non-sentinel patients considered by physicians as suspected to be infected with pandemic A(H1N1)2009 virus, from whom clinical specimens were sent for testing to the National Influenza Center, NIPH-NIH in Warsaw, Poland. Between April 28, 2009 and August 10, 2010, 988 (15.7%) out of the 6,311 specimens were tested by the National Influenza Center, including 798 from non-sentinel sources and 190 from sentinel influenza surveillance network. The non-sentinel specimens were tested by conventional RT-PCR to detect influenza A and in the case of positive specimens – one-step real-time RT-PCR to detect the pandemic virus A(H1N1)2009. In 145 (18.2%) cases, infections with the pandemic virus were confirmed, with the highest number in patients aged 15–25. In 45% of the confirmed cases, a history of travel to other countries was registered. The most common symptoms were fever $\geq 38^{\circ}\text{C}$ (72.7%), cough (50%), sore throat, and myalgia (26.1%). In 40.7% of the swabbed patients, clinical and epidemiological criteria for the novel influenza A(H1N1)2009, set by the European Commission, were met. There were, however, specimens from persons without any reasonable indication for testing for the pandemic virus, specimens collected incorrectly, and documentation without basic information. These weaknesses resulted in unnecessary costs and overload of health care units. An improvement should be achieved in the area of communication between different pandemic players in the future. More attention is also needed to ensure that requirements and recommendations are known and used.

Keywords A(H1N1) virus • Influenza • Pandemic • Respiratory infection • Virus

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34.1 Introduction

On June 11, 2009, World Health Organization (WHO) declared the outbreak of influenza pandemic caused by the novel A(H1N1) virus of swine origin. In Europe, the first cases were confirmed in the United Kingdom and Spain in the end of April 2009 (ECDC 2010a). Since then, the National Influenza Center (NIC) in Poland, located at the Department of Influenza Research of the National Institute of Public Health-National Institute of Hygiene (NIPH-NIH) in Warsaw, Poland, immediately took necessary actions to manage this public health threat and as the first step to introduce appropriate methods of laboratory diagnostics. As of April 28, 2009 until the end of July 2009, the NIC was the only laboratory in Poland responsible for diagnostics of infections caused by the novel virus and authorized by WHO. Afterwards, testing was also performed by laboratories of 10 out of the 16 Voivodship Sanitary-Epidemiological Stations (VSEs) which successively received necessary equipment and became able to perform laboratory diagnostics of A(H1N1)2009 virus by PCR-based methods. Between April 28, 2009, when the first specimen was collected in Poland and August 10, 2010, when the end of the pandemic was announced by WHO, a total number of 6,311 specimens were tested all over the country. Infections with the pandemic A(H1N1)2009 influenza virus were confirmed in 2,378 cases (37.7%). The specimens were collected within the sentinel influenza surveillance system, but most of them originated from the non-sentinel sources, mainly hospitals. The NIC received and tested 988 out of the 6,311 specimens (15.7%), including 798 from the non-sentinel sources (80.8%) and 190 specimens from sentinel influenza surveillance network (19.2%).

The previous influenza pandemic occurred in 1968–1969, affected all age groups and was associated with one to four millions of deaths caused by A(H3N2) virus (WHO 2009b). Since 1997, there have been human infections with highly pathogenic avian influenza virus (HPAI) of A(H5N1) subtype with mortality reaching up to 60%. So far, all infections were due to direct contact with ill or dead birds or their feces, but sustained human-to-human transmission was not confirmed. In 1999, WHO prepared and published ‘Influenza Pandemic Plan. The Role of WHO and Guidelines for National and Regional Planning’ that emphasized the necessity to prepare national influenza pandemic preparedness plans by all member states (WHO 1999). The document was updated in 2005 (WHO 2005) and now is replaced by that of April 2009 (WHO 2009b). Since 1997, concerns of WHO and influenza experts regarding a possible pandemic outbreak were closely related to HPAI A(H5N1) virus. Therefore, the emergence of the novel A(H1N1) virus having pandemic potential in April 2009 was, to an extent, unexpected. The pandemic A(H1N1)2009 influenza virus is a reassortant of Eurasian avian-like swine A(H1N1) virus and North American swine A(H1N1) virus. The latter is a triple reassortant having genes of classical swine A(H1N1) virus, North American avian virus, and human influenza A(H3N2) virus (ECDC 2010b; Neumann and Kawaoka 2011). Consequently, the pandemic A(H1N1)2009 influenza virus has ribonucleic acid (RNA) segments coding neuraminidase (NA) and matrix protein (M) derived from the Eurasian avian-like swine influenza virus, segment coding polymerase PB1 derived from human seasonal influenza A(H3N2) virus, segments coding polymerase PA and polymerase PB2 derived from North American avian influenza virus, while the segment coding hemagglutinin (HA), nucleoprotein (NP), and non-structural protein (NS) derived from the North-American classical swine influenza virus (ECDC 2010b; Neumann and Kawaoka 2011). According to WHO reports, until August 1, 2010 over 214 countries worldwide were affected by the pandemic virus, and over 18,449 deaths were confirmed, including at least 4,879 in WHO EURO Region (WHO 2010a).

The aim of this study was to present epidemiological and clinical data on the 798 non-sentinel patients considered by physicians as suspected to be infected with pandemic A(H1N1)2009 virus, from whom clinical specimens were sent for testing to the NIC.

34.2 Methods

The data presented in this report include specimens collected between April 28, 2009 and August 10, 2010. In each case, a decision which patient should be swabbed was made by a physician. Detailed instructions regarding collection of clinical material, including its storage and transport, were prepared by the NIC and available on the website. Similarly, appropriate information was available on the website of the Chief Sanitary Inspectorate and the Ministry of Health. Phone information was also provided by the staff of the NIC and the National IHR Focal Point. Clinical materials were nasal and throat swabs, less often bronchoalveolar liquid, or tracheal washings. The NIC performed diagnostics of the pandemic influenza A(H1N1)2009 virus by nucleic acid amplification techniques. RNA was extracted from a specimen volume of 140 µL with QIAamp RNA Mini Viral Kit (Qiagen, Germany) according to the manufacturer's instruction. As the first step, conventional one-step reverse transcription-polymerase chain reaction (RT-PCR) assay was done to detect M gene of influenza virus A using Transcriptor One-Step RT-PCR Kit (Roche Diagnostics, Switzerland) and the following sets of primers: until December 2009 primers M30F (TTCTAACCGAGGTCGAAACG) and M264R2 (ACAAAGCGTCTACGCTGCAG) were used (WHO Collaborating Centre for Reference and Research on Influenza, National Institute of Infectious Diseases, Tokyo, Japan) and since December 2009 the modified primers were used: M30F2/08 (ATGAGYCTTYTAACCGAGGTCGAAACG) and M264R3/08 (TGGACAAANCGTCTACGCTGCAG) (WHO Collaborating Centre for Reference and Research on Influenza, National Institute of Infectious Diseases, Tokyo, Japan) (WHO 2009g). The temperature profile was the following: reverse transcription for 30 min at 50°C; inactivation of reverse transcriptase and initial denaturation for 7 min at 94°C; then 45 cycles of denaturation at 94°C for 10 s, annealing at 55°C for 30 s, and extension at 68°C for 55 s. The reaction was completed by a final extension at 68°C for 7 min. All specimens positive for influenza A were then tested by one-step real-time RT-PCR assay performed on the LightCycler 2.0 machine (Roche), using the protocol developed by the Centers for Disease Control and Prevention (CDC; Atlanta, USA) and SuperScriptTMIII Platinum® One-Step Quantitative RT-PCR System (Invitrogen, USA) to detect HA gene of the pandemic influenza virus A(H1N1)2009 (WHO 2009a).

Data regarding individual patients were analyzed by sex, age, seasonal influenza vaccination status, symptoms of illness, and epidemiological and clinical criteria included into the case definition of the pandemic influenza A(H1N1)2009 (European Commission 2009).

34.3 Results

Data on the age of the swabbed patients, their sex, and the vaccination status is presented in Table 34.1. The highest proportion of specimens was received from patients aged 15–44 (61.7%, if patients of the unknown age were excluded). The specimens collected from men and women were relatively equally represented (47.7% vs. 52.3%). In 537 (67.3%) out of the 798 patients, information on the vaccination status against seasonal influenza in the epidemic season 2008/2009 or 2009/2010 was given by a physician. Among them, there were 7.3% of the vaccinated patients.

In 145 (18.2%) cases of 798 non-sentinel specimens, infections with the pandemic virus were confirmed. Most of the confirmed cases were found in the age group 15–25 years (42.8%). Similarly to the total number of specimens analyzed, the positive specimens were collected equally from men and women (51.0% vs. 49.0%). In the case of 99 patients, information on the vaccination status was known. Among them only 6.1% were vaccinated against seasonal influenza in the epidemic season 2008/2009 or 2009/2010. Detailed information is given in Table 34.2.

Table 34.1 Non-sentinel patients suspected to be infected with A(H1N1)2009 influenza virus from whom clinical specimens were collected and laboratory tested at the Dept. of Influenza Research, National Influenza Center, NIPH-NIH, between April 28, 2009 and August 10, 2010

	No. of patients	%
Age (year)		
0–4	37	4.6
5–14	102	12.8
15–25	269	33.7
26–44	209	26.2
45–64	127	15.9
≥65	31	3.9
Unknown	23	2.9
Gender		
Male	380	47.6
Female	417	52.3
Unknown	1	0.1
Vaccination against seasonal influenza in the epidemic season 2008/2009 or 2009/2010		
Yes	39	4.9
No	498	62.4
Unknown	261	32.7
Total	798	100

Table 34.2 Non-sentinel patients with laboratory confirmed infection with A(H1N1)2009 influenza virus from whom clinical specimens were collected and laboratory tested at the Dept. of Influenza Research, National Influenza Center, NIPH-NIH, between April 28, 2009 and August 10, 2010

	No. of patients	%
Age		
0–4	11	7.6
5–14	32	22.1
15–25	62	42.8
26–44	27	18.6
45–64	9	6.2
≥65	4	2.7
Unknown	0	0.0
Gender		
Male	74	51.0
Female	71	49.0
Unknown	0	0.0
Vaccination against seasonal influenza in the epidemic season 2008/2009 or 2009/2010		
Yes	6	4.1
No	93	64.1
Unknown	46	31.7
Total	145	100

The first laboratory-confirmed case in Poland was diagnosed on May 6, 2009 (week no. 19/2009). This specimen was collected from a woman aged 37 old who visited the USA and developed symptoms less than a week after the return to Poland.

The highest number of the non-sentinel specimens was received by the NIC in weeks 30–31/2009 (July 20, 2009–August 2, 2009). During summer holidays, i.e., between week 27/2009 (June 29,

Fig. 34.1 Number of clinical specimens tested (n=798) and positive (n=145) for the pandemic influenza A(H1N1)2009 in different calendar weeks between April 27, 2009 and August 10, 2010

Fig. 34.2 Proportion of specimens positive for the pandemic influenza A(H1N1)2009 in different age groups

2009- July 5, 2009) and week 35/2009 (August 24–30, 2009), 52% of all specimens were collected. Since week 33/2009 (August 10–16, 2009), the number of specimens gradually decreased, although between week 45/2009 (November 2–8, 2009) and 48/2009 (November 23–29, 2009) an increase in the number of specimens was observed (Fig. 34.1).

A proportion of positive specimens among all specimens tested between the age groups ranged from 7.1% in the patients aged 45–64 to 31.4% in those aged 5–14 (Fig. 34.2).

Fig. 34.3 Epidemiological data on the patients with laboratory confirmed A(H1N1)2009 infection (n=145)

*(n=1) China, Germany, Hungary, India, Ireland, the Netherlands, Sweden (n=2) Ukraine

Fig. 34.4 Proportion of patients visiting different countries in whom A(H1N1)2009 infection was laboratory confirmed after their return to Poland (n=66)

In 45.5% of patients with laboratory confirmed infection with A(H1N1)2009 influenza virus, a history of travel to other countries was registered (Fig. 34.3). Among them, almost 40% returned from Spain and 30% visited the USA and/or Canada or Mexico (Fig. 34.4).

Information on the clinical symptoms was available for 88 out of the 145 patients with laboratory confirmed A(H1N1)2009 infection. Among them, the most common symptoms were fever $\geq 38^{\circ}\text{C}$ (72.7% of patients), cough (50.0%), sore throat (26.1%), myalgia (26.1%), and coryza (20.5%) (Table 34.3).

Table 34.3 Clinical symptoms in patients with laboratory confirmed infection with A(H1N1)2009 influenza virus (n=145) from whom clinical specimens were collected and laboratory tested at the Dept. of Influenza Research, National Influenza Center, NIPH-NIH, between April 28, 2009 and August 10, 2010

Symptom	No. of patients	%
Fever $\geq 38^{\circ}\text{C}$	64	44.1
Subfebrile body temperature	5	3.4
Cough	44	30.3
Sore throat	23	15.9
Myalgia	23	15.9
Coryza	18	12.4
Malaise	10	6.9
Headache	9	6.2
Chills	6	4.1
Abdominal pain	3	2.1
Lack of appetite	2	1.4
Vomiting	4	2.8
Dyspnea	2	1.4
Conjunctivitis	2	1.4
Nausea	2	1.4
Diarrhea	1	0.7
Sinusitis	1	0.7
Lacrimation	1	0.7
Stomatitis	1	0.7
Dizziness	1	0.7
No symptoms (contact with the confirmed case)	7	4.8
No specific data available	57	39.3

40.7% of all swabbed patients met the European Commission's (EC 2009) clinical and epidemiological criteria for novel influenza A(H1N1)2009. When the population of patients was broke down to infected and non-infected persons, 56% (56 out of the 75) of those with confirmed infection and 38.1% (167 out of the 438) of those with not confirmed infection met these criteria. Detailed data for all swabbed patients are presented in Table 34.4.

34.4 Discussion

The results presented in this article indicate two different aspects of the influenza pandemic A(H1N1)2009 in Poland. The first is the similarity of the infection picture to that in other countries, while the second reveals weaknesses in the response to a pandemic situation which should be treated as a lesson for the future.

Since the first information on the emergence of the novel influenza virus in Europe, the NIC started preparations for the diagnosis of infections caused by this pathogen. A formal cooperation was maintained with WHO and the European Centre for Disease Prevention and Control (ECDC) and there were informal contacts with the members of the WHO Global Influenza Surveillance Network (GISN) and the European Influenza Surveillance Network (EISN). Certainly, cooperation with the most important national bodies was also in place, including the Ministry of Health, the Chief Sanitary Inspectorate, and the Government Center for Security. The NIC regularly participated in the meetings

Table 34.4 Clinical and epidemiological criteria of the novel influenza A(H1N1)2009 case (European Commission 2009) met in patients from whom clinical specimens were collected and laboratory tested at the Dept. of Influenza Research, National Influenza Center, NIPH-NIH, between April 28, 2009 and August 10, 2010

Criteria met ^a	All patients	%	Infected patients	%	Non-infected patients	%
Clinical & epidemiological	209	26.2	42	29.0	167	25.6
Only epidemiological	240	30.1	28	19.3	212	32.5
Only clinical	14	1.8	0	0.0	14	2.1
Epidemiological criteria met, but no information on clinical criteria	72	9.0	24	16.6	48	7.4
Clinical criteria met, but no information on epidemiological criteria	41	5.1	11	7.6	30	4.6
Epidemiological criteria not met and no information on clinical criteria	8	1.0	0	0.0	8	1.2
Clinical criteria not met and no information on epidemiological criteria	28	3.5	5	3.4	23	3.5
Neither epidemiological nor clinical criteria met	14	1.7	0	0.0	14	2.1
No information on clinical and epidemiological criteria	172	21.6	35	24.1	137	21.0
Total	798	100	145	100	653	100

^aEC epidemiological criteria met when at least one of the following three occurred in 7 days before disease onset: (1) close contact to a confirmed case of novel influenza A(H1N1) virus infection while the case was ill, (2) traveling to an area where sustained human-to-human transmission of novel influenza A(H1N1) was documented, and (3) working in a laboratory where samples of the novel influenza A(H1N1) virus were tested

EC clinical criteria met when one of the following three occurred: (1) fever >38°C and signs and symptoms of acute respiratory infection, (2) pneumonia (severe respiratory illness), and (3) death from unexplained acute respiratory illness

of the National Influenza Pandemic Committee providing scientific background and advice on the interventions or recommendations that should be prepared for physicians, laboratory workers, and the community. In the first step, the NIC prepared detailed instructions regarding the collection of clinical specimens (types of specimens, technical ways of their collection, the optimal time for specimen collection, storage and transport conditions, etc.) that were available on the website of the NIPH-NIH and on other relevant websites. Moreover, staff of the NIC was able to respond to any questions regarding the diagnostics of the pandemic virus and in the first months of the pandemic, until the end of July 2009, this type of information, along with the diagnostics, was given to all interested parties on a 24-h basis. Most of the specimens (80.8%) tested by the NIC were from outside the sentinel influenza surveillance network, i.e., mainly from hospitals. This resulted from the recommendations of the Minister of Health, the National Adviser for the Infectious Diseases, the National Adviser for Epidemiology, and other members of the National Influenza Pandemic Committee. According to them, all patients meeting clinical criteria and epidemiological criteria of the infection with the novel influenza virus A(H1N1)2009 had to be admitted to hospital infectious wards and the hospitals were responsible for the specimen collection and sending for laboratory testing. Since August 3, 2009, the above recommendations were modified and patients not severely ill were treated at home. This change of the recommendations also explained a decrease of the number of specimens received by the NIC since week 33/2009 (August 10–16, 2009). This decrease also resulted from the fact that laboratories of the VSEs gradually became able to perform laboratory diagnostics of A(H1N1)2009 virus. Thus, since August 2009, the NIC played mainly a role of a national reference laboratory verifying questionable results and coordinating the sentinel influenza surveillance system. It is interesting that following the decrease above outlined, a secondary increase in the number of non-sentinel specimens between weeks 45–48/2009 was observed. This situation could be partially associated with a significant

increase of the number of influenza-like illness (ILI) cases in the Ukraine in November 2009 and a recommendation of the National Influenza Pandemic Committee in Poland to intensify tracing of the suspected cases in the voivodships bordering the Ukraine (WHO 2009f). Nevertheless, in first part of November 2009, twofold to almost fourfold increase of the ILI incidence was registered in the whole of Poland compared with the last week of October 2009 (107.8 ILI cases/100,000 between 8th and 15th of November 2009 vs. 65.5 ILI cases/100,000 between November 1–7, 2009 vs. 27.8 cases/100,000 between October 23–31, 2009) (National Institute of Public Health-National Institute of Hygiene and Chief Sanitary Inspectorate 2009a, b, c).

This study shows that adolescents and young adults were the most frequently affected subjects; 48.2% of confirmed cases in the 15–25 years old and only 2.7% in the ≥ 65 years old group. This finding is consistent with the observations made in most of other countries (WHO 2009c). Metaanalysis performed by Khandaker et al. (2011) on data pooled from five studies from the United Kingdom, Germany, Peru, the USA, and Saudi Arabia showed that 64% of the confirmed cases were in patients aged 10–29. The authors also show that the highest proportion of positive cases among all specimens collected in a given age group was present in patients up to 25 years of age (29.7% of positive specimens in 0–4 years old; 31.4% in 5–14 years old, and 23% in 15–25 years old subjects).

This higher rate of infections at younger age and lower in the elderly are not surprising as HA glycoprotein of the A(H1N1)2009 pandemic virus is more similar to HA glycoprotein of the 1918 pandemic virus and its close descendants than to the seasonal influenza viruses A(H1N1) circulating recently (Garten et al. 2009; Greenbaum et al. 2009; Krause et al. 2010; Smith et al. 2009; Xu et al. 2010). This was also confirmed by the seroepidemiological studies showing that people aged >60 years have pre-existing cross-reactive specific antibodies to the pandemic virus A(H1N1)2009 (Booy et al. 2011; Hancock et al. 2009; Ikonen et al. 2010; Miller et al. 2010; Rizzo et al. 2010, WHO 2009d, 2010b). The finding of this study that the most affected group was patients aged up to 25 may also be related to summer holidays. During 9 weeks of the holiday time, 52% of all non-sentinel specimens from a 67-week long period of analysis were collected. The present study shows that 45.5% of infected patients had a history of travel to other countries earlier affected by the pandemic influenza virus. It is also a reasonable assumption that young people were more likely to travel than older ones. It is also known that at least to mid-August 2009 all confirmed influenza cases in Poland, i.e., those diagnosed at the NIC and VSESS laboratories were imported or linked with the imported cases. A similar situation was observed in other European countries, while a sustained virus transmission at a national level was observed in Spain, Germany, and the United Kingdom.

An equal frequency of infection in either sex, a fairly mild course, and the presence of gastrointestinal symptoms in about 14% of cases seen in the present study are all in accord with the observations made in other studies (Khandaker et al. 2011; Neumann and Kawaoka 2011; WHO 2009c, e). We also analyzed vaccination status of the swabbed patients regarding seasonal influenza vaccination in the epidemic season 2008/2009 and 2009/2010. These seasonal vaccines did not provide any protection against the A(H1N1)2009 pandemic virus. Nevertheless, it was interesting to find out how many of the swabbed patients were vaccinated with the seasonal vaccine, especially taking into account a strong interest of the community in acquiring the pandemic vaccine, on the one hand, and a low seasonal influenza vaccination rate in the general Polish population, on the other hand. The results show that barely 7.3% of the swabbed patients were vaccinated. The vaccination rate was no different among the positive cases, amounting to 6.1%. These values are similar to the seasonal influenza vaccination rates registered for a few epidemic seasons in the total population in Poland. In the epidemic season 2008/2009 barely 5.2% of the total Polish population was vaccinated against influenza, in 2009/2010 – 5.5%, and in 2010/2011 – 5.0% (Brydak 2010, 2011). According to the European Union's Council Recommendation 2009/1019/EU of December 22, 2009, all member states should prepare and implement national, regional, and local plans or appropriate policies to improve seasonal influenza vaccination coverage to be able to achieve a target of 75% vaccination coverage in the older age groups and, if possible, also in other risk groups and healthcare workers, preferably by the season

2014/2015 (European Council 2009). In Poland, there is no specific national program for human seasonal influenza. There is a National Health Program prepared for the years 2007–2015 and one of its strategic objectives is to increase the effectiveness of prevention against infectious diseases and infections. One of the priorities of this program is to reduce the incidence of infectious diseases that are preventable by vaccinations. Nevertheless, influenza is not mentioned in the program by name (National Health Program for years 2007–2015). A low interest in influenza prophylaxis causes that there is still much to do to increase influenza vaccination coverage in Poland.

Considering the emergence of the pandemic influenza virus A(H1N1)2009, the ECDC prepared, on the request of the EC, a case definition for the illness caused by this pathogen, including clinical, epidemiological, and laboratory criteria (European Commission 2009). The definition determines that a case under investigation is any person meeting both clinical and epidemiological criteria. Certainly, the use of this case definition has been important, particularly in the first months of the pandemic when there was no sustained transmission of the virus observed and the majority of the cases were imported. The results of this study show that the above case definition has not been known or used by many physicians who collected clinical specimens and sent it to the NIC. Both types of criteria were met in 40.7% of the swabbed patients. It is also known that among patients with the laboratory confirmed infection, clinical and epidemiological criteria were met in 56.0% of them, while among non-infected patients – in 38.1% of them. These results confirm that collection of specimens from patients meeting both types of criteria could increase a probability to single out persons really infected with the pandemic virus. The EC case definition was available in Polish on the most important websites providing information to physicians and the community during the pandemic, and in the recommendations prepared for physicians by the Minister of Health, the National Adviser for the Infectious Diseases and the National Adviser for Epidemiology. Therefore, there is a question of whether distribution of this information was poor and ineffective or physicians just did not use the information in practice. The problem was repeatedly discussed during the meetings of the National Pandemic Committee. There is a probability that physicians acted under strong pressure put out by patients and consequently tried to avoid any negative reactions. Nevertheless, testing the specimens collected from patients who did not meet both epidemiological and clinical criteria resulted in unnecessary costs and overload of laboratory staff and healthcare workers. Even when transmission of the pandemic virus was already sustained and confirmed in the Polish community, laboratory diagnostics should be performed for patients meeting clinical criteria and preferably for patients from the risk groups or with a severe course of the disease, according to WHO recommendations (WHO 2009h). The experience of the NIC shows that some specimens have been collected from asymptomatic patients, e.g., from seven healthcare workers from the same hospital department who had no symptoms, but had contact with a confirmed case. Moreover, these healthcare workers asked the NIC to perform diagnostics for influenza A(H1N1)2009 and for influenza B, despite the fact that in the confirmed case infection with the pandemic variant was diagnosed. This examples show the lack of knowledge on the nature of influenza viruses, even among healthcare workers.

Beside specimens collected from persons without any reasonable indication for laboratory testing for the pandemic virus, there have also been specimens collected incorrectly, e.g., those with too much volume of transport medium, collected too late after the onset of symptoms, stored for too long a time, or with attached documentation without basic information on the patient and/or physician who ordered the testing. Specific data on such issues were not presented in the present article. However, these weaknesses also resulted in unnecessary costs, waste of valuable time, and overload of health care units and the staff of the NIC. It is unjustified that after the end of the pandemic was announced by WHO, i.e., since August 2010 through the epidemic season 2010/2011, physicians kept on sending specimens to the NIC asking to perform diagnostics only for the pandemic virus A(H1N1)2009. They excluded from the diagnostics the influenza virus B and other respiratory viruses causing influenza-like illnesses such as respiratory syncytial virus, parainfluenza viruses, human metapneumovirus, coronaviruses, adenoviruses, or rhinoviruses which all can be detected in one PCR reaction by using

multiplex commercially available kits, e.g., Labopass™ RV detection kit (Cosmo), ResPlex II Plus Panel RUO (Qiagen), Seeplex RV12 ACE Detection kit (Seegene), or Seeplex RV15 OneStep ACE Detection kit (Seegene) (Brunstein et al. 2008; Do et al. 2011; Kim et al. 2009; Lee et al. 2010; Roh et al. 2008; Yoo et al. 2007).

There are some limitations of this study. The problem was that specific clinical and epidemiological information was not provided by physicians for all the swabbed patients. Nevertheless, available data presented in this study show that the picture of the infections caused by the pandemic A(H1N1)2009 influenza virus in Poland was similar to that in other countries and point to a few key elements that have to be improved before the outbreak of the next influenza pandemic. These elements are the need for rapid and effective communication between different pandemic players, effective access to timely, concise, and legible information and the recommendations to increase the seasonal influenza vaccination rates.

Conflicts of interest: The authors declare no conflicts of interest in relation to this article.

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