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## Determining symptoms for chest radiographs in patients with swine flu (H1N1)

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### Summary

**Background:**

The question arises about the chest X-ray findings and clinical symptoms in swine flu and about the most important clinical finding when correlated with the chest radiograph. Should physicians order a chest X-ray in each patient suspected of having swine flu?

**Material/Methods:**

There were 179 patients with a high suspicion of swine flu. All 179 patients had an initial chest radiograph. As many as 65 males (representing 56% of the projected study population) had a normal chest radiograph, while 35 males (representing 55.6% of the study population) had an abnormal chest X-ray. As many as 51 females (representing 44% of the population) had a normal chest X-ray, while 20 females (representing 44% of the study population) had abnormal chest X-rays.

**Results:**

Polymerase chain reaction (PCR) was not a determining factor for normal vs. abnormal chest X-ray (CXR). Rapid antigen test was not a determining factor for normal vs. abnormal CXR. Fever was not a determining factor for normal vs. abnormal CXR. Cough appears to be a determining factor for normal vs. abnormal CXR. Sore throat appears to be a determining factor for normal vs. abnormal CXR. Chest pain was not a determining factor for normal vs. abnormal CXR. Presence of cough with PCR was statistically significant.

**Conclusions:**

In my opinion, chest radiographs in patients with suspected H1N1 should only be obtained if there is a cough or sore throat. Other symptoms associated with H1N1 do not warrant a chest radiograph unless absolutely necessary.

**Key words:**

swine flu (H1N1) • chest X-ray • symptoms

**PDF file:**

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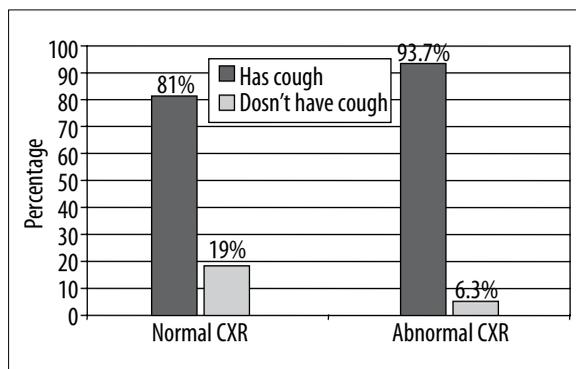
### Background

Although most cases of swine-origin influenza A (H1N1) virus have been self-limited, a question arises about the chest X-ray findings and clinical symptoms in swine flu and about the most important clinical finding when correlated with the chest radiograph. Should physicians order a chest X-ray in each patient suspected of having swine flu? I described radiographic findings associated and correlated with the symptoms of swine-origin influenza A (H1N1) infection. The study was approved by hospital ethics committee. As the study was retrospective, an informed consent was waived. I retrospectively reviewed the electronic archive of the infection control department for cases of positive real-time PCR results of nasal swabs or aspirates and positive or negative results of Quick's test. Afterwards,

the results were correlated with the chest radiograph performed on the day of admission.

### Material and Methods

This method revealed 179 patients with a high suspicion of swine flu. All 179 patients had an initial chest radiograph, in the postero-anterior projection. In 150 out of 179 patients, a follow-up radiograph was performed within 1–2 days after the initial visualization: 5 patients had a bedside antero-posterior projection. Postero-anterior radiographs were obtained using a General Electric X-ray unit (GE Healthcare) Milwaukee, USA. The following parameters were used for the postero-anterior projection: 90 kV, 4 mAs, film focus distance of 180 cm. The bedside antero-posterior projections were obtained with a mobile unit (AMX4, GE Healthcare)



**Figure 1.** Graph showing cough vs. chest X-rays (CXR) in patients with H1N1.

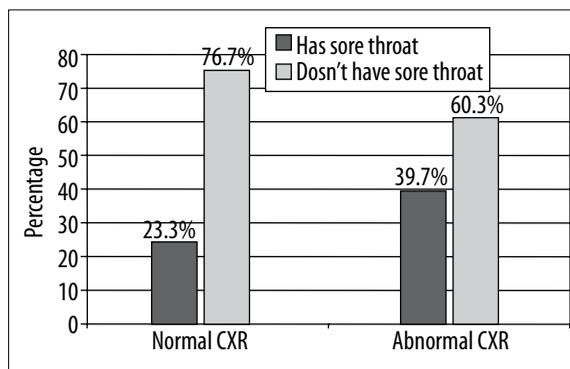
using the following parameters: 90 kV, 4 mAs and film-focus distance of 100 cm. None of the patients in this study underwent multidetector CT. Image analysis: an experienced radiologist reviewed the chest radiographs. All images were reviewed on a PACS workstation GE Healthcare (Milwaukee, USA). The radiographs were assessed as normal or abnormal. Abnormal radiographs were further classified for the presence of ground-glass opacity, nodular opacity, consolidation, or pleural effusion. As many as 65 males (representing 56% of the projected study population) had a normal chest radiograph, while 35 males (representing 55.6% of the study population) had an abnormal chest X-ray. As many as 51 females (representing 44% of the population) had a normal chest X-ray, while 20 females (representing 44% of the study population) had an abnormal chest X-ray.

### Statistical analysis

The statistical analysis was performed with an SPSS software package (version 16.0; SPSS, Chicago, IL). Student's t-test was used to analyze the relationship between chest X-rays (CXR) and age. Chi-squared test was used to analyze the relationship between CXR and gender, CXR and PCR, CXR and rapid antigen test, CXR and cough, as well as CXR and sore throat. Fisher's exact test was used to analyze the relationship between CXR and fever, CXR and dyspnea, CXR and hemoptysis, as well as CXR and chest pain.

### Results

A total number of 179 patients was enrolled and labeled with the diagnosis of swine flu. Their age ranged from 2 to 89 years. One hundred of them were males with a mean age of  $26.2 \pm 17.2$  years. There were 79 females with a mean age of  $27.19 \pm 24.4$  years. Age was not a determining factor ( $P$ -value = 0.777) according to the student's t-test for independent groups. Chest X-rays were obtained in all these patients: 65 males representing 56% of the study population had a normal chest X-ray (CXR), while 35 males, representing 55.6% of the study population, had abnormal chest X-rays. As many as 51 females, representing 44% of the population, had a normal CXR, while 28 females (44% of the study population) had an abnormal CXR. Sex was not a determining factor (with a  $P$ -value of 0.999 according to the chi-squared test). From among patients with a normal CXR, 79 (73.1%) had a positive PCR, while 29 patients (26.9%) had a negative PCR. Among those with an abnormal



**Figure 2.** Graph showing sore throat vs. CXR in patients with H1N1.

chest X-ray, 44 patients (74.6%) had a positive PCR and 15 patients (25.4%) had a negative PCR. PCR, therefore, was not a determining factor for normal vs. abnormal CXR as the  $P$ -value was 0.98, according to the chi-squared test. From among patients with a normal CXR, 29 (25%) had a positive rapid antigen test, while 87 (75%) had a negative rapid antigen test. Among those with an abnormal CXR, 12 patients (19%) had a positive rapid antigen test, while 51 patients (81%) had a negative rapid antigen test.

Once again, rapid antigen test was not a determining factor for normal vs. abnormal CXR, as the  $P$ -value was 0.472 according to the chi-squared test. Of those patients with a normal CXR, 109 (94%) had a fever, and 7 (6%) had no fever. Among those with an abnormal CXR, 96.8% had a fever and only 2 (3.2%) had no fever. Fever was not a determining factor for normal vs. abnormal CXR, as the  $P$ -value was 0.327.

Of the patients with a cough, 94 (81%) had a normal CXR, while 22 (19%) had no cough. Among those with an abnormal CXR, 59 (93.7%) had a cough and only 4 (6.3%) had no cough (Figure 1). Therefore, cough appears to be a determining factor, with a  $P$ -value of 0.039, according to the chi-squared test. Among those with a normal CXR, 27 (23.3%) had a sore throat, while 89 (76.7%) had no sore throat. Among those with an abnormal CXR, 25 (3%) had a sore throat, while only 38 patients had no sore throat (Figure 2). Therefore, sore throat appears to be a determining factor, with a  $P$ -value of 0.33, according to the chi-squared test. There were 7 (6%) patients with a normal CXR and dyspnea, and 109 (94%) with a normal CXR and without dyspnea. Among patients with an abnormal chest X-ray, there were 3 (4.8%) with dyspnea and 60 (95.2%) without dyspnea. The correlation between dyspnea and chest X-ray was not statistically significant ( $P$ =0.507 according to the Fisher's exact test). None of the patients with a normal CXR had hemoptysis, while only 1 (1.6%) had an abnormal CXR. The remaining 62 patients (96%) had no hemoptysis. Hemoptysis was not a determining factor ( $P$ -value = 0.352 according to the Fisher's exact test). Only 6 patients with a chest pain had a normal CXR (5.2%) while the majority – 110 (94.8%) had no chest pain. Two patients with a chest pain (3.2%) had an abnormal CXR, while 61 patients (96.8%) had no chest pain at all. Chest pain was not a determining factor, as the  $P$ -value was 0.420 according to the Fisher's exact test. Of the patients with a positive PCR (123), 112 (91.1%) had a cough, while only 11 (8.9%) had no cough. Among patients with a negative PCR (44), 32 (72.7%) had

**Table 1.** Statistical relationship between chest radiographs and clinical symptoms.

|               | CXR            |                 | P-value  |
|---------------|----------------|-----------------|----------|
|               | Normal (n=116) | Abnormal (n=63) |          |
| Age           | 26.21±17.21    | 27.19±24.44     | 0.777*** |
| Gender        |                |                 |          |
| Male          | 65 (56%)       | 35 (55.6%)      | 0.999*   |
| Female        | 51 (44%)       | 28 (44.4%)      |          |
| PCR           |                |                 |          |
| + ve          | 79 (73.1%)     | 44 (74.6%)      | 0.987*   |
| - ve          | 29 (26.9%)     | 15 (25.4%)      |          |
| Rapid Ag test |                |                 |          |
| + ve          | 29 (25%)       | 12 (19%)        | 0.472*   |
| - ve          | 87 (75%)       | 51 (81%)        |          |
| Fever         |                |                 |          |
| Yes           | 109 (94%)      | 61 (96.8%)      | 0.327**  |
| No            | 7 (6%)         | 2 (3.2%)        |          |
| Cough         |                |                 |          |
| Yes           | 94 (81%)       | 59 (93.7%)      | 0.039*   |
| No            | 22 (19%)       | 4 (6.3%)        |          |
| Sore throat   |                |                 |          |
| Yes           | 27 (23.3%)     | 25 (39.7%)      | 0.033*   |
| No            | 89 (76.7%)     | 38 (60.3%)      |          |
| Dyspnea       |                |                 |          |
| Yes           | 7 (6%)         | 3 (4.8%)        | 0.507**  |
| No            | 109 (94%)      | 60 (95.2%)      |          |
| Hemoptysis    |                |                 |          |
| Yes           | 0 (0%)         | 1 (1.6%)        | 0.352**  |
| No            | 116 (100%)     | 62 (98.4%)      |          |
| Chest Pain    |                |                 |          |
| Yes           | 6 (5.2%)       | 2 (3.2%)        | 0.420**  |
| No            | 110 (94.8%)    | 61 (96.8%)      |          |

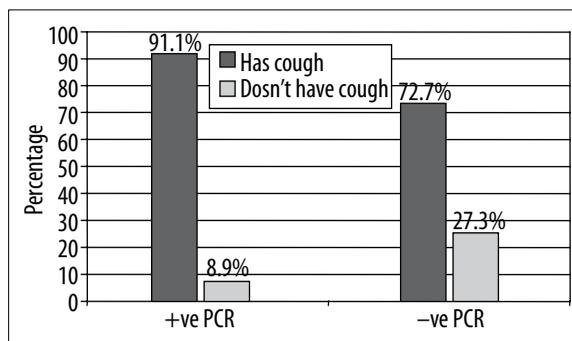
\* According to the chi-squared test; \*\* according to the Fisher's exact test; \*\*\* according to the student's t-test for independent groups.

a cough, while only 12 (27.3%) had no cough (Table 2 and Figure 3).

The correlation between cough and PCR is statistically significant (P-value = 0.006, according to the chi-squared test) (Table 1). From among 123 patients with a positive PCR, 112 had a cough. Out of those 112, 68 had a normal CXR, while 44 patients had an abnormal chest X-ray. There were 11 patients who had no cough and a normal CXR. None of the patients without cough had an abnormal CXR. There were 44 patients with a negative PCR. As many as 32 of them had a cough, and out of those who had a cough, 21 had a normal CXR and 11 had an abnormal CXR (Table 3 and Figure 4A, B). There were 12 patients with a negative PCR and no cough. Eight of them had a normal CXR and 4 had an abnormal CXR (Table 1).

**Discussion**

Global swine-origin influenza virus (H1N1) was first reported in Mexico in April 2009 [1]. The main route of



**Figure 3.** Graph showing PCR vs. CXR in patients with H1N1.

**Table 2.** Statistical relationship between cough and PCR.

|          | PCR         |            | P-value |
|----------|-------------|------------|---------|
|          | +ve (n=123) | -ve (n=44) |         |
| Cough    | 112 (91.1%) | 32 (72.7%) | 0.006*  |
| No cough | 11 (8.9%)   | 12 (27.3%) |         |

\* According to the chi-squared test.

**Table 3.** Statistical relationship between cough and PCR.

|          | PCR         |            | P-value |
|----------|-------------|------------|---------|
|          | +ve (n=123) | -ve (n=44) |         |
| Cough    | 112 (68/44) | 32 (21/11) | 0.006*  |
| No cough | 11 (11/0)   | 12 (8/4)   |         |

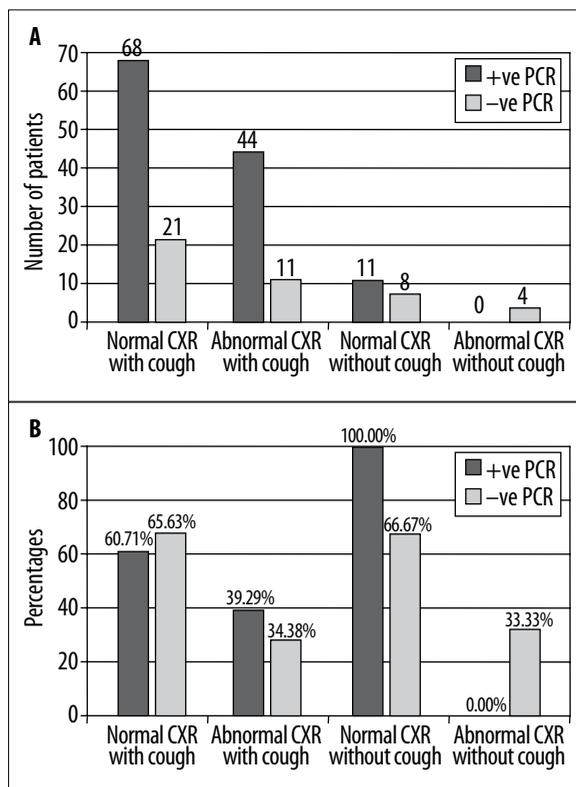
\* According to the chi-squared test.

N.B.: (N/Ab) (Normal CXR / Abnormal CXR).

transmission is respiratory inhalation of a large-particle respiratory droplet and possibly the droplet nuclei [2]. The incubation period is from 1 to 7 days but in most cases it is 1-4 days. An infected person can be assumed to be shedding the virus from day one of onset until the complete resolution of the symptoms [2]. The most common clinical findings at presentation are fever, cough, dyspnea and respiratory distress [3-5].

Fever is a common symptom in these patients. However, it is not always present: it has been seen to be absent in some out-patients and in up to 1 out of 6 surviving hospitalized patients [6]. In our study, it was also found to be a non-determining factor for an abnormal chest X-ray, with a P-value of 0.327. As much as 96.8% of the analyzed patients had fever and only 3% had no fever. Another common symptom is cough. In our study group, none of the patients had diarrhea or vomiting, contrary to the study by Petrocello et al. [7].

Initial chest radiographs in children with swine flu are often normal, but increased peribronchial markings and hyperinflation were observed by Lee et al. [8] However, other authors [3,9] found these patients to have extensive involvement of lungs with either ground-glass opacities, or consolidation, either unilaterally or bilaterally (Figure 5) For the purpose of our study, the patients were categorized into either a group



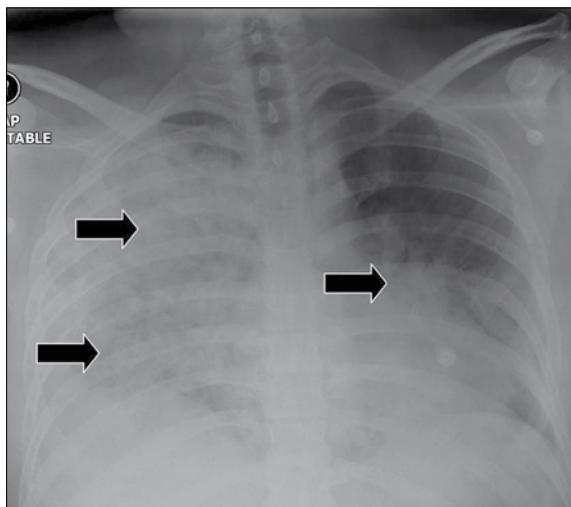
**Figure 4A,B.** Graph showing PCR vs. CXR and cough in patients with H1N1.

with normal chest radiographs, or a group with abnormal chest radiographs (peribronchial markings, hyperinflation, ground-glass opacities or consolidation). Cough is a common symptom and in our study it was correlated with chest radiograph (it was a determining factor, with a P-value equal to .039, as the majority of patients with an abnormal chest X-ray (94%) had a cough, while only 6% had no cough).

Likewise, absence of a sore throat appears to be a determining factor (as the P-value is equal to 0.033) and among patients who had a normal chest X-ray, only 23% had a sore throat, while 76% had no sore throat, whereas among patients who had an abnormal chest X-ray, 3% had a sore throat, while only 38 patients had no sore throat. Dyspnea, hemoptysis and chest pain were not a determining factor for a normal or abnormal chest X-ray.

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**Figure 5.** Chest radiograph in a 28-year-old male with diagnosed swine flu showing bilateral extensive diffuse ground-glass opacities (arrows).

The presence of cough with a positive PCR and abnormal chest radiograph was statistically significant, as the P-value was 0.006 (Table 2 and Figure 3). There were 68 patients (60.7%) who had a positive PCR, a normal chest radiograph and cough. There were 21 patients (65.6%) who had a negative PCR and a normal chest radiograph with cough.

There were 44 (39.29%) patients who had a positive PCR and an abnormal chest radiograph with cough, and 11 patients (34.3%) with a negative PCR and an abnormal chest radiograph and cough, see Figure 4a and 4b.

Therefore, my recommendation is that patients who have a cough and/or sore throat should only have chest X-ray when other symptoms do not warrant a chest radiograph. It would be therefore possible to avoid exposure to ionizing radiation in patients, especially those very young. When we add the results of PCR, then it turns out that only patients with a positive PCR and cough should have chest X-ray.

## Conclusions

I believe that chest radiographs in patients with suspected H1N1 should only be obtained if there is a cough or sore throat. Other symptoms associated with H1N1 do not warrant chest radiograph unless absolutely necessary.