ESTIMATING THE INCIDENCE OF SEVERE ACUTE RESPIRATORY INFECTIONS (SARI) IN FOUR SENTINEL HOSPITALS BY MEANS OF CAPTURE-RECAPTURE METHOD WITH TWO DATA SOURCES

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Abstract: *Introduction: SARI surveillance was implemented in Romania in the fall of 2009 during the 2009 pandemic influenza virus A (H1N1). There were designated as sentinel 4 counties and Bucharest and a total of 12 sentinel hospitals. SARI surveillance continued in the 2010-2011 season, in a total number of 8 sentinel counties and Bucharest and a total number of 26 sentinel hospitals (hospitals for infectious diseases, pediatrics, pulmonology, emergency hospitals). Objective: To estimate the incidence of SARI and assessing the completeness of detecting such cases, between 15 November 2010 and 27 February 2011 (15 weeks of surveillance) in four hospitals in Bucharest and Iaşi, designated as sentinel for SARI surveillance, as well as assessing the level of reporting the detected cases. Method: capture-recapture method with two data sources was used to estimate SARI incidence between 15 November 2010 and 27 February 2011 (15 weeks of surveillance) and to assess the completeness of sentinel system as the primary source of data, in four sentinel hospitals: the "Grigore Alexandrescu" Emergency Hospital for Children, Bucharest, the "Victor Babeş" Infectious Diseases Hospital, Bucharest, the "Saint Mary" Emergency Hospital for Children from Iaşi, and the "Sf. Spiridon" Infectious Diseases Hospital, Iaşi. Results: In absolute numbers, the infectious disease hospitals reported a total of 20 of the 80 cases detected in the observation sheets, while the pediatric hospitals reported only 51 of the 476 cases detected in the observation sheets. This indicates that 1 in 8 cases have been reported in SARI surveillance system. By observing the proportion of 1 at 8, the actual number of SARI cases estimated for the 4 selected hospitals is 2228 (95% CI: 2009-2447). Overall, the calculated sensitivity of the surveillance system was of 33%. Conclusions: Although the sensitivity of SARI sentinel surveillance system 15 weeks after implementation was relatively low, it brought useful information by monitoring the severe cases of acute respiratory infection. The evaluation of the surveillance systems is an important action to improve their performance. Training the staff involved in surveillance is an important support function of the system.*

Rezumat: *Introducere: Supravegherea SARI a fost implementată în România în toamna anului 2009, în timpul pandemiei de gripă cu virus A(H1N1)2009 pandemic. Au fost desemnate ca sentinelă 4 judeţe şi Municipiul Bucureşti şi un total de 12 spitale sentinelă. Supravegherea SARI a continuat în sezonul 2010-2011, într-un număr de 8 judeţe sentinelă şi Municipiul Bucureşti şi un total de 26 spitale sentinelă (spitale de boli infecţioase, pediatrie, pneumologie, spitale de urgenţă). Obiectiv: Estimarea incidenţei SARI şi evaluarea completitudinii depistării acestor cazuri, în perioada 15 noiembrie 2010 - 27 februarie 2011 (15 săptămâni de supraveghere), în patru spitale din Bucureşti şi Iaşi, desemnate ca sentinelă pentru supravegherea SARI, precum şi evaluarea gradului de raportare a cazurilor depistate. Metoda: Metoda de captura-recaptură cu două surse de date a fost utilizată pentru estimarea incidenţei SARI în perioada 15 noiembrie 2010 - 27 februarie 2011 (15 săptămâni de supraveghere) şi pentru evaluarea completitudinii sistemului sentinelă ca sursă primară de date, în patru spitale sentinelă: Spitalul Clinic de Urgenţă pentru Copii „Grigore Alexandrescu" Bucureşti, Spitalul Clinic de Boli Infecţioase „Victor Babeş" Bucureşti, Spitalul de Pediatrie de Urgenţă „Sfânta Maria" Iaşi şi Spitalul Clinic de Boli Infecţioase „Sfântul Spiridon" Iaşi. Rezultate: În cifre absolute, spitalele de boli infecţioase au raportat un număr de 20 din cele 80 de cazuri depistate din foile de observaţie, iar spitalele de pediatrie numai 51 din cele 476 cazuri depistate din foile de observaţie. Acest lucru indică faptul că 1 din 8 cazuri SARI au fost raportate în sistemul de supraveghere. Respectând proporţia de 1 la 8, numărul real de cazuri SARI estimat pentru cele 4 spitale selectate este de 2228 (CI 95%: 2009-2447). Per total, sensibilitatea calculată a sistemul de supraveghere a fost de 33%. Concluzii: Deşi sensibilitatea sistemului de supraveghere sentinelă pentru SARI după 15 săptămâni de la implementare a fost destul de scăzuta, acesta şi-a arătat valoarea prin informaţiile aduse în monitorizarea cazurilor severe de infecţie acută respiratorie. Evaluarea sistemelor de supraveghere reprezintă o acţiune importantă pentru îmbunătăţirea performanţelor acestuia. Pregătirea personalului implicat în supraveghere reprezintă o funcţie de suport importanta a sistemului.*

INTRODUCTION

Influenza is an acute viral disease affecting the respiratory tract. Occasionally, it can cause severe forms of the disease by the appearance of primary viral pneumonia, or by increasing the susceptibility to acquire secondary bacterial infections of the lower respiratory tract. Also, influenza can exacerbate the chronic diseases (e.g. chronic lung disease or cardiovascular diseases) leading to hospitalization and sometimes, even to death. The young children, the elderly, the pregnant women and the people with chronic illnesses are traditionally considered population groups at high risk of developing influenza complicated forms.

SARI surveillance was implemented in Romania in the fall of 2009, during the 2009 pandemic influenza virus A (H1N1). There were designated as sentinel 4 counties and Bucharest and a total of 12 sentinel hospitals.

SARI surveillance continued in the 2010-2011 season, in a total number of 8 sentinel counties and Bucharest and a total number of 26 sentinel hospitals (hospitals for infectious diseases, pediatrics, pulmonology, emergency hospitals).

Laboratory diagnosis of SARI cases was performed by RT-PCR testing (rtRT-PCR) specimens collected from SARI cases, consistent with the case definition given by World Health Organization (WHO).

PURPOSE

To estimate the incidence of SARI and assessing the completeness of detecting such cases, between 15 November 2010 and 27 February 2011 (15 weeks of surveillance) in four hospitals in Bucharest and Iaşi, designated as sentinel for SARI surveillance, as well as assessing the level of reporting the detected cases.

METHODS

The capture-recapture method with two data sources was used to estimate SARI incidence between 15 November 2010 and 27 February 2011 (15 weeks of surveillance) and to assess the completeness of sentinel system as the primary source of data, in four sentinel hospitals: the "Grigore Alexandrescu" Emergency Hospital for Children, Bucharest, the "Victor Babeş" Infectious Diseases Hospital, Bucharest, the "Saint Mary" Emergency Hospital for Children from Iaşi, and the "Sf. Spiridon" Infectious Diseases Hospital, Iaşi.

The diagram of capture-recapture method with two data sources is presented in the figure below:

Figure no. 1. Diagram of capture-recapture method
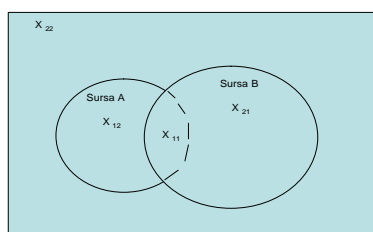
Legend:

X_{22} = number of SARI cases that have not been "seen" by any of the sources

X_{12} = number of SARI cases that have been "seen" only by the A source (sentinel-type surveillance system)

X_{21} = number of SARI cases that have been "seen" only by the B source (research of the observation sheets)

X_{11} = number of SARI cases that have been "seen" by both sources, A and B

The data from the two sources were recorded in a 2x2 table type:

Table no. 2. The representation of the data from the two sources

		Source A		
		+	−	
Source B	+	X_{11}	X_{21}	N_2
	−	X_{12}	X_{22}	
		N_1		N

Formulas used:

$N = X_{11} + X_{21} + X_{12} + X_{22} = Nobs. + X_{22}$

In order to avoid X22, which may be known only by the use of a third data source, the following formula was used:

$N = N_1 N_2 / X_{11}$

The sensitivity of the sentinel surveillance system was calculated using the formula:

$X_{12} \, 100 / N$

The confidence interval was calculated as follows:

$Var_N = N_1 N_2 X_{12} X_{21} / X_{11}^3$

$95\% CI = N \pm 1,96 \sqrt{Var_N}$

If the numbers of those four cells of the table were less than 50, the following formula was used:

$N = (N_1 + 1)(N_2 + 1) / X_{11} + 1$

$Var_N = (N_1 + 1)(N_2 + 1) X_{12} X_{21} / X_{11}^3 (X_{11} + 2)$

$95\% CI = N \pm 1,96 \sqrt{Var_N}$

The data analysis was performed using the EpiInfo 2000 program.

Selection of data sources

According to SARI surveillance methodology, the cases detected on the above case definitions are notified by the sentinel hospitals within 24 hours of detection using the SARI case file.

SARI sentinel surveillance system represented the "A" data source, within the system, SARI cases are diagnosed in each sentinel hospital, based on WHO clinical case definitions.

The secondary source, called source "B" was defined as: the data existing in the clinical observation sheets of the patients hospitalized for any respiratory pathology in the four selected hospitals.

The selection criteria of the four hospitals were based on the fact that these ones, although participating in the sentinel system reported fewer SARI cases in the studied period.

SARI cases detected by researching the clinical observation sheets ("B" list) were compared to those identified and reported in the sentinel surveillance system ("A" list), based on common elements: name and surname initials, date of birth, gender, date of admission.

RESULTS

During the 15 weeks of surveillance, the total number of SARI cases reported within the surveillance system in the four selected hospitals gathered in the "A" data source was of 71 cases compared with 556 SARI cases detected by checking the observation sheets within the study ("B" source). This indicates that 1 in 8 SARI cases have been reported in the SARI surveillance system.

By observing the proportion of 1 at 8, the actual number of SARI cases estimated for the 4 selected hospitals is 2228 (95% CI: 2009-2447).

By dividing the results by the type of the hospitals included in the study into two categories: infectious diseases hospitals (2) and pediatric hospitals (2), the results show a sensitivity of the surveillance system of 25% for the infectious disease hospitals and of 38% for the pediatric hospitals (after excluding from the study the cases with popping sternum as the sole sign of severity in children under 5 years). In absolute

numbers, the infectious disease hospitals reported a total of 20 of the 80 cases detected in the observation sheets, while the pediatric hospitals reported only 51 of the 476 cases detected in the observation sheets

Overall, the calculated sensitivity of the surveillance system was of 33%.

The relation of the cases detected in adults compared to those detected in children was of 5.95.

DISCUSSIONS

By trying to analyze the common characteristics of the cases that were not reported in the surveillance system by the four selected sentinel hospitals, we found that most patients admitted to the two pediatric hospitals (72%) had chest tube clogging as the sole sign of disease severity. They were not considered by physicians as SARI cases although the signs presented were consistent with the WHO case definition for children under 5 years old. This led to a significant decrease in the sensitivity of the surveillance system.

Ever since the development of the methodology of the study, we found as possible limits the lack of recording in some clinical observation sheets regarding the "medical history", the time of onset, clinical examination and the daily evolution of the disease, the respiratory rate, which was found, with the consequence of underestimating the number of SARI cases that would have entered the surveillance system.

CONCLUSIONS

Although the sensitivity of SARI sentinel surveillance system after 15 weeks of implementation was only of 33%, it showed its value by the information brought in monitoring the severe cases of acute respiratory infection. The evaluation of the surveillance systems is an important action to improve performance. Given the difficult case definitions and the novelty of the system, training the staff involved is essential for achieving optimal indicators. Given the estimated incidence of SARI cases within the study as 40.7% 000 and a positivity rate of 37.5% for influenza in the 2010-2011 season, we estimate that 15.3%000 of SARI cases in the studies area could have been prevented by vaccination.

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