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Original Research

Forecasts of health care utilization related to pandemic A(H1N1)$_{2009}$ influenza in the Nord-Pas-de-Calais region, France

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ABSTRACT

Objectives: To describe and evaluate the forecasts of the load that pandemic A(H1N1)$_{2009}$ influenza would have on the general practitioners (GP) and hospital care systems, especially during its peak, in the Nord-Pas-de-Calais (NPDC) region, France.
Study Design: Modelling study.
Methods: The epidemic curve was modelled using an assumption of normal distribution of cases. The values for the forecast parameters were estimated from a literature review of observed data from the Southern hemisphere and French Overseas Territories, where the pandemic had already occurred. Two scenarios were considered, one realistic, the other pessimistic, enabling the authors to evaluate the 'reasonable worst case'. Forecasts were then assessed by comparing them with observed data in the NPDC region – of 4 million people.
Results: The realistic scenarios forecasts estimated 300,000 cases, 1500 hospitalizations, 225 intensive care units (ICU) admissions for the pandemic wave; 115 hospital beds and 45 ICU beds would be required per day during the peak. The pessimistic scenario's forecasts were 2–3 times higher than the realistic scenario's forecasts. Observed data were: 235,000 cases, 1585 hospitalizations, 58 ICU admissions; and a maximum of 11.6 ICU beds per day.
Conclusions: The realistic scenario correctly estimated the temporal distribution of GP and hospitalized cases but overestimated the number of cases admitted to ICU. Obtaining more robust data for parameters estimation – particularly the rate of ICU admission among the population that the authors recommend to use – may provide better forecasts.

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Introduction

In April 2009, the World Health Organization (WHO) announced the emergence of a new influenza A(H1N1) virus, identified in Mexico and the United States (US).[1] The virus spread rapidly throughout the world. On 27th April 2009, the first cases were reported in the United Kingdom (UK) and Spain in travellers returning from Mexico.[2,3] On 1st May, the first imported cases were detected in France in the Paris region by the French Institute for Public Health Surveillance (Institut de veille sanitaire, InVS).[4] On 11th June 2009, the WHO decided to raise the level of influenza alert from phase 5 to phase 6, thereby declaring a pandemic.[5]

In June 2009, French regional health authorities solicited several InVS Regional Units named CIRE (Cellule de l'InVS en région) to estimate the impact that pandemic $A(H1N1)_{2009}$ would have on the French general practitioners (GP) and hospital care system, especially during its peak.

At the time of the pandemic, very few tools were available to support decision makers in pandemic influenza preparedness (FluAid, FluSurge, Epigrass and InfluSim).[6–8] Furthermore, the indicators of health care utilization proposed by these applications were not completely adapted to the requests of French Regional health authorities. In addition, the configuration of some of the tools lacked flexibility, especially regarding the choice of the input parameters.

Accordingly, the authors developed a simple, tailor-made forecasting tool. Taking into account several epidemiological parameters characterizing the pandemic, its aim was to provide indicators which would help in planning GP and hospital care utilization before the arrival of the pandemic wave.

The main objective of this study was to describe the development of French regional forecasts of health care utilization related to pandemic $A(H1N1)_{2009}$ – especially during its peak – and to present them for the Nord-Pas-de-Calais (NPDC) administrative region (northern France). The secondary objective was to assess the quality of these forecasts for the NPDC region by comparing them with observed data from influenza surveillance systems.

Methods

Case definitions

A GP case was defined as a person with an influenza-like illness (ILI) – sudden fever >39 °C (>102 °F) with myalgia and respiratory signs – who had a medical consultation. A hospital case was defined as an inpatient with a coding of flu (J09, J10 or J11) from the 10th revision of the International Classification of Disease in the information system of the hospital. An intensive care unit (ICU) case was a confirmed case of A(H1H1) influenza by Reverse Transcription-Polymerase Chain Reaction hospitalized in an ICU.

Scenarios developed

Two scenarios were developed: a realistic scenario and a pessimistic one. The latter was based on the logic of the 'reasonable worst case' as recommended by the European Centre for Disease Control and Prevention (ECDC).[9] It represented a relatively unlikely scenario, which national and local planners needed to prepare for if they wanted to have confidence that they would be able to cope with the peak demand in care during the 2009 pandemic.[9]

Implementation of the tool

The tool was implemented using MS Excel© 2003 from June to September 2009. Planning models and algorithms were programmed using Visual Basic for Application (VBA). This tool was made available to all participating CIRE.

Tool outputs: indicators of health care utilization

The burden on the GP care system was estimated by the overall and weekly number of cases consulting a GP and the daily number of visits per GP for any given week. The load on the hospital care system was estimated using the following indicators: total and weekly number of hospital and ICU admissions and daily number of required hospital and ICU beds for any given week.

Tool modelling of the epidemic curve

The epidemic curve was modelled using an assumption of normal distribution of overall cases in a geographical area sufficiently large in size and population, in practice, a French administrative region.

The weekly distribution of total cases (i.e. the proportion of cases of the pandemic wave in a given week) was provided by the probability density function of a normal distribution with standard deviation σ and mean μ. Weekly attack rates (AR) were obtained by calculating the product of the proportion of cases for a given week and the overall AR of the wave. Therefore, this model had three parameters: overall AR, μ and σ.

Mean (μ) corresponded to the peak week. However, as the modelling work performed aimed to quantify *a priori* the number of cases at the pandemic peak, it was not important to know when the peak would occur. Standard deviation (σ) corresponded to the dispersion of cases around the peak; the higher the σ, the narrower the peak.

The temporal distribution of both hospital and ICU admissions was obtained using the same method, taking into account the hospitalization rate (HR) and the ICU admission rate (IR), respectively. ICU admissions were not subtracted from hospital admissions. Accordingly, patients admitted to ICU were considered to be admitted to a hospital unit (pre- or post-ICU) for the same mean lengths of stay (LOS) as that of patients admitted to a standard hospital unit (i.e. not an ICU).

Tool input parameters

During October 2009, the authors estimated the values of the parameters required to create the indicators. They initially used the InVS report, dated 28th September 2009,[10] which was based on available data at the time for the Southern hemisphere. They then updated these data using various materials