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Letter to the editor

Forecasting in Infectious Disease

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LETTER TO THE EDITOR

Forecasting is the process by which future events can be predicted. Real-time forecasts of infectious diseases can help public health planning, especially during outbreaks [1]. There are unlimited ways to develop a forecast. Some use relatively simple methodology to extrapolate or project the historical pattern, but the more formal statistical methods of extrapolation usually make use of a mathematical forecasting model [2]. Some essential features in infectious disease epidemiology make it necessary to use quantitative projection techniques for proper forecasting. In principle, forecasting should not be regarded as providing the answer but rather as a tool to increase understanding and highlight important processes.

There are several steps in the forecasting process which make it effective and these should be undertaken systematically. They begin with defining the problem and then investigating the variables of interest and the reliability of data. This is followed by analysing the data and then selecting the appropriate forecasting method(s) and applying it to determine the final forecast. For non-infectious diseases there is no such connection; an individual who develops heart disease does not increase the risk of other individuals in the population with regard to heart disease. A consequence of this is the fact that protection of an individual from infection reduces the risk of infection for other individuals and any intervention preventing infection in a proportion of individuals. A simple deduction of the above fact is that infectious diseases require mathematical tools that are non-linear since biological populations are controlled by processes that are non-linear.

Forecasting has been used to predict epidemics to project incidence and mortality of specific diseases, to select the most cost effective intervention strategy and to design control programmes. A good surveillance system is essential for proper action now and in the future. It is an important tool to provide the base from which to forecast. Data integrity and accuracy is another prerequisite for successful forecasting. It is important to see that the data used in the forecasting process is "healthy data". This entails transparency, consistency and completeness in data reporting. The quality of data is critical in developing good forecasts and enabling appropriate steps to be taken to plan for the future.

Predictions should be linked with response initiatives so that they can be updated based on these actions. In this way, officials responsible for containing an outbreak can determine the reliability of predictions, the effectiveness of their responses and the level of effort required for an on-going outbreak [3]. Further issues include international cooperation in sharing sometimes sensitive surveillance data, as well as the burden of prediction validation.

Forecasting has also been used extensively to help design many control programmes in which vaccination was the main intervention strategy [4]. In this regard mathematical models have been used to determine the minimum coverage rate required in continuous mass vaccination to eliminate infection and to determine the optimum age for vaccination, the choice of vaccine and the need for booster doses in Figure 1 [5].

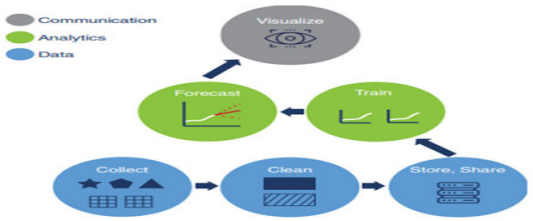

Figure 1: The forecasting workflow. **Note:** Communication(●) Analytics (●), Data (●).

Generating infectious disease forecasting results that will be useful for managing outbreaks follows a workflow with three main strata: data (blue circles), analytics (green circles), and communication (gray circle). Taken together, these pieces build a workflow that uses analytics to provide decision-makers with information that could be used to plan response activities [6].

Competing interest

Health services planning and disease prevention programmes require some idea of the future burden of disease in order to guide the health policy process. Decisions and choices need to be made today in order to cope with the expected disease burden

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in the future; forecasting provides the information support for this process. This is of particular importance in preventing unusual occurrence of infectious diseases (epidemics) or at least in being prepared for it so that it can be controlled efficiently. However, the results of forecasting models should be regarded with a certain degree of caution, particularly because of the wide confidence intervals linked to the projections made.

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Forecasting is the process by which such information can be obtained, providing the prerequisites and the steps for effective forecasting are soundly met. Forecasting in infectious diseases necessitates good epidemiological knowledge and practice on the one hand and a functional surveillance system on the other. Statistical and mathematical expertise is also needed to develop the models. However, without sound epidemiological thinking, the process can be misleading.

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