Nowcasting Influenza Locally in Sweden

[Announcer] This program is presented by the Centers for Disease Control and Prevention.

[Sarah Gregory] Hello, I'm Sarah Gregory, and today I'm talking with Dr. Armin Spreco, a researcher in the field of syndromic surveillance at Linköping University in Sweden. We'll be discussing the use of nowcasting to detect timing and spread of flu epidemics.

Welcome, Dr. Spreco.

[Armin Spreco] Thank you very much, Sarah.

[Sarah Gregory] I've done previous podcasts with Dr. Cowling. He lives in Hong Kong, so how did these authors come together to do a study about flu in Swedish localities?

[Armin Spreco] A very good question. The Swedish....the Swedish and the Hong Kong researchers met through the...through the World Health Organization Collaborating Centre Network for Safety Promotion sometime in 2007–08, I think....12 to 13 years ago, I believe. Professor Cowling was one of the...of several postdoc researchers. Since then, we have stayed in touch and visited each other several times. And this has been helped by that the ECDC (or the European CDC) is located in Stockholm, the capital of Sweden, and Professor Cowling traveled there often. Due to the situation in Hong Kong, he is interested in early detection and prediction of epidemic outbreaks at the local level just as we are.

[Sarah Gregory] How is nowcasting or short-term forecasting, different from regular forecasting? Are there different results?

[Armin Spreco] Well, I would say that the results aren't different, but nowcasting as a term was first introduced in meteorology as far as I remember. And the term is…in meteorology used to denote situational awareness and short-time forecasting, often only a couple of hours…hours ahead. For instance, weather conditions for airports are nowcasted for...for a short period of time ahead to make it easier for flight…flight coordinators to change runways or even airports. In our case, we do not make forecasts on an hourly basis. However, we did produce short-time forecast up to maybe 2 weeks ahead, which we choose to denote as nowcasting. Forecasting (the term) is both for short- and…and long-term forecasts, and to distinguish between the two, we introduced the term…we introduced the term "nowcasting" for short-time forecasts in infectious diseases forecasting.

[Sarah Gregory] So, why local rather than national forecasting?

[Armin Spreco] Well, there are two main reasons for that. The first...the first reason is that national public health policies in response to infectious disease outbreaks often find the responsibility for healthcare resource allocation to local health authorities such as counties, regions, or similar.

The second reason is that, for instance, the onset and...and the peak timing of influenza can differ largely between local and district areas, or counties in this case, within…within nations or states. If large variations in disease transmission patterns exist between the counties, epidemic forecast at national or state level might not...sufficient...might not be sufficiently informative for local response to epidemics. The importance of taking the local context into regarding an epidemic forecasting has been further emphasized during...during this ongoing COVID-19 pandemic. And

we have also in this study seen...seen large variations between...between counties, which we…which further strengthens the reasons why...why local forecast should be produced instead of national.

[Sarah Gregory] What can nowcasting do to help with flu epidemics?

[Armin Spreco] Well, locally…locally validated and reliable forecasts of the timing and the spread of influenza during regular influenza seasons and also pandemics can make it easier to implement…to implement resource allocation in healthcare. Forecasts can make it easier for hospitals and primary healthcare centers to prepare for management of influenza patients, for example, by preparing intensive care unit resources or by postponing some elective...elective procedures. Furthermore, forecasts can also help inform the local or the regional authorities when the peak of the epidemic will occur, and that the healthcare.....that the health service routines soon can return to normal. Also, warning about potential high intensity influenza transmission and the potential need for social distancing measures can be achieved by reliable...reliable forecasts.

[Sarah Gregory] Why did you do this study? What were you looking for initially?

[Armin Spreco] We had developed this...this method used here previously and we had evaluated it on one county, one small county during a 5-year period where the...where we saw that the findings were…were promising. However, involving only one county in previous studies—a relative small county, as I said, with a population just below a half million inhabitants—and the relative short period of time, we felt like...we felt that the longer prospective evaluation on several regions was needed to ascertain validity of the results and to draw reliable conclusions about...about the generalizability of the method. But we initially were looking for here was whether general conclusions could...could be drawn about this method, or in other words, whether the method is applicable on other…other regions than the region where it was initially developed.

[Sarah Gregory] What period of time did this evaluation cover?

[Armin Spreco] This evaluation period set for approximately ten years between 2009 and 2019, and included 9 influenza seasons and one pandemic outbreak (the swine flu in 2009).

[Sarah Gregory] And on what areas of Sweden did you focus your study?

[Armin Spreco] Yeah, the focus was on the 3 largest counties in Sweden, namely Stockholm County, West Gothia County, and Scania County. These regions or these counties have a population between 1.3 and 2.2 million inhabitants, and they covered together approximately 50% of the total population in Sweden. These regions also included the three largest metropolitan areas or cities in Sweden, namely Stockholm, Gothenburg, and…and Malmö.

[Sarah Gregory] What kind of data did you use?

[Armin Spreco] We used two sources of data from the countywide health information systems. The first was the daily numbers of the clinically diagnosed influenza cases. And these cases (these influenza cases) were identified by using codes from the International Classification of Diseases for influenza, while the other....data source was daily syndromic chief complaint data from the local telenursing service. And these calls....these telenursing call cases were identified

by using the chief complaints associated with influenza symptoms such as fever, cough, and breathing difficulties.

[Sarah Gregory] In your study you used nowcasting for detection of epidemic start, peak timing, and peak intensity. Would you explain all that to us?

[Armin Spreco] Yeah, I will do my best here to answer your question. As you mentioned in the question, the functions of this developed nowcasting method were detection of the start of the epidemic and the forecasting the peak day as well as the peak intensity. First, the method detects the start of the epidemic by using daily diagnostic data from primary care visits or hospitalizations due to influenza. When that is done, or when we are sure that...that the epidemic has started, the search for the peak timing begins, which also is the turning point of the epidemic. Well, since it is practically impossible to know in advance when…when the peak will occur by just looking at or by just using diagnostic data, we use telenursing data to find the timing. And we do this because we have in previous studies seen or been able to see that...that telenursing calls due to flu-related....due to flu-related symptoms are strongly associated with diagnostic data with a time lag of about 14 days, which means that telenursing calls occur about two weeks before healthcare visits. And finally, after predicting the timing of the peak or assuming when the peak occurs or will occur, we make a forecast of the peak intensity (or the height of it, if you wish) this time by using diagnostic data again.

[Sarah Gregory] And what did you find?

[Armin Spreco] Well, we first thought that the onset of influenza season could vary by up to four weeks for the...or between the three analyzed regions. And this further emphasizes the importance of forecasts on a local or regional level instead of forecasts on state or nation levels. Also, the peak intensities could vary largely between...between the counties in this study. As I said in the beginning here, the purpose of evaluating the local detection method or function would allow healthcare centers to prepare for management of influenza patients—for instance, by preparing intensive care units. And this detection function showed...showed satisfactory performance in all 3...in all 3 counties studied in this paper.

The second component—the peak-timing prediction function—was aimed at informing the local authorities when the peak will occur, and that...and that the health routines soon can be permitted to return to normal. This component showed satisfactory performance as well. The peak-timing were made....the peak-timing predictions or forecasts were made eight to ten days before the peak occurred, and they were quite accurate in most cases. This finding contrasts with the current…with the current practices in most European settings, where the peak of an influenza season is retrospectively determined from surveillance data, approximately 10 to 14 days after (and I emphasize here) after the peak has occurred.

The third component here—the peak-intensity forecasting or the forecasting of the peak-intensity level—was aimed at warning the local authorities about high-intensity influenza transmission and the potential need for social distancing measures. This component provided satisfactory information for influenza seasons in two out of the three counties studied, namely for Stockholm and West Gothia.

[Sarah Gregory] Were there any challenges or limitations to this method?

[Armin Spreco] The method is quality-assured as far as is practically possible since it is strongly based on validation and evaluation. And we know in advance when it can be assumed to work well, and when it can be assumed to work less...less good. And this…this allowed us to adapt the interpretations of the forecasts accordingly. A typical...a typical example of something that can disrupt forecasts is social unrest. Anxiety often leads to people reacting with changed behavior, as has been seen during this...this pandemic...this ongoing COVID-19 pandemic, which in turn changes the conditions for the forecast. Also, the data quality must be assured, which unfortunately is not always the case. And although the evaluated nowcasting method is automatized and runs on routinely collected healthcare data, the accuracy of the nowcast depends on the stability of the...of the data supply.

Furthermore, the outcomes observed in this study in...in one of the three counties analyzed (namely Scania County) raises concerns about the vulnerability of nowcasts to sociodemographic dynamics. The capital of Scania County, Malmö, with a population just below a half million and the capital of Denmark (other…another Scandinavian country here), Copenhagen, with a population of two million inhabitants...these two cities are connected by a bridge…by a bridge that provides for daily commuting between...between these metropolitan areas. And the labor markets are closely integrated between the two...in these two cities. And the epidemic situation in the highly cosmopolitan Copenhagen region might have had a stronger influence on influenza epidemics in Scania County than the epidemic situation in the neighboring regions had had on the other two counties studied (in the Stockholm and West Gothia).

[Sarah Gregory] What are the next steps or further studies on this method that you would like to see?

[Armin Spreco] As always, further work could be done, and further work that hopefully improves this...this method. In the present method, we have only used...we have only used aggregated data on the daily level without taking into regard age, gender, and other patient characteristics. Also, we have not used information about different virus types that circulate from season to season—for instance, influenza type A and B and subtypes. Furthermore, implementation of the present—or at least the modified version—of the present method is something that we aim at both in and outside Sweden. On the other hand, the method has already been used in practice, so if we apply this method with slight modifications during the COVID-19 pandemic and we apply the method to make forecasts on the number of hospitalizations and forecast on the hospital...hospital bed need. Given the positive outcome, we have a lot of...a lot of interesting findings to publish in the near future.

[Sarah Gregory] What's the most important public health message in your study?

[Armin Spreco] That's a very good question, very good question. Influenza forecasting methods must be evaluated on a routine basis in order to understand their performance…performance and their characteristics and all....and allow continuous improvements of the methods. We also found that it is highly relevant to implement nowcasting of influenza season....nowcasting of influenza season at the local level because there are large, within nation variations in the spreading of the virus. Validated local nowcasting is therefore of major interest for local healthcare planning during epidemics since it helps healthcare management to allocate resources for all patient groups, not only...not only for influenza patients.

[Sarah Gregory] What are the best ways that people can protect themselves from getting the flu?

[Armin Spreco] Well obviously, vaccination is one way. Other important measures are personal hygiene—washing hands often, and so on. Also, in my opinion, a reasonable (and here I really mean reasonable) social distancing when...when being sick is important. We have during this ongoing pandemic seen that...that social distancing has been effective. And although the seasonal flu is milder than COVID-19, for the ongoing pandemic here all of us should have in mind that the seasonal flu can be fatal for...for the vulnerable groups, and therefore we should consider a reasonable amount of social distancing also during...during the seasonal flu.

[Sarah Gregory] So okay, well tell about your work and what you like most about it.

[Armin Spreco] Well, everything...I love everything about my job here. Lately, since the beginning of this year I've had...I've had full focus on the ongoing pandemic. To Sweden, it came in the beginning of March…but March, but my colleagues and I followed...followed the situation in the world, first in China and then in Italy early on. During the spring and the first wave of the pandemic in Sweden (and hopefully the only wave in Sweden and the other countries), we had daily contact with healthcare managements from several Swedish regions and produced daily forecasts on the number of hospitalized patients as well as the bed unit need (as I mentioned earlier here). This was at the same time stimulating, challenging, and...and exhausting. What I like most about this is that the work we performed had practical meaning through the forecasts that we produced were highly valuable for healthcare managements and, in turn, for all patients…for all patients, not only COVID-19 patients.

Before the pandemic started here, I was involved (and still am) in numerous varying projects. I work on a project called Equal Healthcare, where we analyze whether the healthcare in Sweden (Swedish region) is equal regarding age, gender, sociodemographics, origin, and so on. And this...this region in Sweden is quite representative for...for Sweden in general. So, the findings we get there can be applicable for all of Sweden. Furthermore, I'm also involved in projects on sports medicine, mostly athletics and...and soccer, or as we Europeans call it, the "real football," in which we study associations between injuries and diverse aspects regarding personal characteristics and personal behaviors of the athletes. So, what I like most about my job in general is the diversity being involved in many interesting and important projects.

[Sarah Gregory] It does sound like you have a wide variety of very interesting projects. What do you do....what do you enjoy doing in Sweden in your personal time?

[Armin Spreco] What personal time? There has been a little personal time during this pandemic, but usually I like spending time with my family, especially my 2-year-old boy. I also spend time with the rest of the family—my wife, my parents, sister, her sons, and so on. It's something that I really appreciate. And when time allows, I read...I like to read, and I like to spend time outdoors in the nature. I find it relaxing, and I enjoy doing that...that as well.

[Sarah Gregory] Thank you for taking the time to talk with me today, Dr. Spreco.

[Armin Spreco] Thank you for inviting me, Sarah.

[Sarah Gregory] And thanks for joining me out there. You can read the November 2020 article, Nowcasting (Short-Term Forecasting) of Influenza Epidemics in Local Settings, Sweden, 2008–2019, online at cdc.gov/eid.

I'm Sarah Gregory for *Emerging Infectious Diseases*.

[Announcer] For the most accurate health information, visit <u>cdc.gov</u> or call 1-800-CDC-INFO.