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Major article

Building-level analyses to prospectively detect influenza outbreaks in long-term care facilities: New York City, 2013-2014

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Background: Timely outbreak detection is necessary to successfully control influenza in long-term care facilities (LTCFs) and other institutions. To supplement nosocomial outbreak reports, calls from infection control staff, and active laboratory surveillance, the New York City (NYC) Department of Health and Mental Hygiene implemented an automated building-level analysis to proactively identify LTCFs with laboratory-confirmed influenza activity.

Methods: Geocoded addresses of LTCFs in NYC were compared with geocoded residential addresses for all case-patients with laboratory-confirmed influenza reported through passive surveillance. An automated daily analysis used the geocoded building identification number, approximate text matching, and key-word searches to identify influenza in residents of LTCFs for review and follow-up by surveillance coordinators. Our aim was to determine whether the building analysis improved prospective outbreak detection during the 2013-2014 influenza season.

Results: Of 119 outbreaks identified in LTCFs, 109 (92%) were ever detected by the building analysis, and 55 (46%) were first detected by the building analysis. Of the 5,953 LTCF staff and residents who received antiviral prophylaxis during the 2013-2014 season, 929 (16%) were at LTCFs where outbreaks were initially detected by the building analysis.

Conclusions: A novel building-level analysis improved influenza outbreak identification in LTCFs in NYC, prompting timely infection control measures.

Influenza is a serious health concern among elderly populations, as an estimated 90% of deaths due to influenza infection occur in persons aged 65 years and older.[1] Influenza can be rapidly transmitted within nursing homes and other chronic-care facilities, affecting individuals at high risk for complications.[2] Although long-term care facilities (LTCFs) in New York State are required by law to provide free influenza vaccines to residents and employees, vaccine coverage for employees has been low in recent seasons,[3] and vaccine effectiveness in elderly persons can be modest.[4,5] When influenza occurs in institutional settings, timely detection is critical to successfully control outbreaks through chemoprophylaxis and other infection control measures.[6-10] Adults were at high risk for severe influenza illness and complications during the 2013-2014 influenza season, which was characterized in New York City (NYC) by a first wave predominated by pH1N1 activity and a second wave predominated by influenza B activity.[11,12]

Historically, influenza surveillance coordinators at the New York City Department of Health and Mental Hygiene (DOHMH) typically were first notified of influenza activity in LTCFs when the facility submitted a nosocomial outbreak report form to the New York State Department of Health (NYSDOH). In the 2010-2011 influenza season, to more proactively detect outbreaks, DOHMH initiated an analysis using approximate text matching and a key-word search on addresses to flag passive reports of laboratory-confirmed

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influenza case-patients residing in LTCFs. This analysis seemed to identify outbreaks that may have otherwise gone unreported, but a formal evaluation was not performed.

At the beginning of the 2013-2014 influenza season, an enhanced, automated building-level analysis was implemented to leverage routine geocoding of case-patients with laboratory-confirmed influenza. Our objective was to evaluate the utility of this building analysis in improving the prospective detection of influenza outbreaks in LTCFs in NYC.

MATERIALS AND METHODS

Passive surveillance and geocoding of laboratory-confirmed influenza case-patients

Cases of laboratory-confirmed influenza have been reportable in NYC since 2006.[13,14] All clinical and commercial laboratories that perform testing report positive results of influenza tests (eg, rapid antigen test, viral culture, nucleic acid amplification test/polymerase chain reation, reverse-transcription polymerase chain reaction, and immunofluorescence) electronically via the New York State Electronic Clinical Laboratory Reporting System. Since mid-2012, each report received for NYC residents, whether electronically or through manual data entry, is processed (including using Coding Accuracy Support System address reference files from the US Postal Service to correct and standardize addresses[15]) and flows into a disease database system (Maven, Consilience Software, Austin, Tex).

The disease database system is fully integrated with a geocoder using the LION geodatabase from the NYC Department of City Planning.[16] The first geocodable residential address received in the disease database system for each case-patient is used to assign geocoded attributes such as latitude, longitude, and a building identification number (BIN). A BIN is an immutable 7-digit numerical identifier assigned by the Department of City Planning and unique to each building in NYC.[17] BINs have previously been used for NYC surveillance purposes to track pesticide health effects[18] and the safety of buildings following the World Trade Center attacks in 2001,[19] and BINs have been included in routine geocoding output for cases of laboratory-confirmed influenza and other reportable diseases since mid-2012.

Identifying influenza in LTCFs

Eligible facilities

In New York State, LTCFs are a type of Article 28 facility; that is, a health care facility that operates with a certificate granted under Article 28 of Public Health Law and is regulated by NYSDOH. Article 28 facilities are required to report the presence of confirmed or suspected influenza outbreaks (defined as 2 or more cases of influenza-like illness on the same unit within 7 days, or 1 laboratory-confirmed influenza case) to NYSDOH. For LTCFs in NYC, outbreak notification triggers a DOHMH investigation to characterize and monitor the outbreak and to provide guidance regarding appropriate infection control measures.

Outbreak identification methods in prior use

Article 28 facilities are required to report confirmed or suspected influenza outbreaks via the Nosocomial Outbreak Reporting Application (NORA), an online secure Web program.[20] Once a NORA report is submitted and processed by NYSDOH, DOHMH influenza surveillance coordinators are alerted by e-mail.

When LTCF patients are transferred to a hospital and test positive for influenza within 48 hours, hospital infection control staff often notify DOHMH of these nosocomial cases acquired in the LTCF.[21] In such instances when the affected LTCF staff are not also notified of the positive influenza test for their resident, a NORA report may not be submitted immediately.

In addition, DOHMH conducts active laboratory surveillance during each influenza season. Commercial and hospital laboratories are contacted each week to obtain the number of respiratory specimens submitted for virologic testing and the number of positive specimens for influenza and other respiratory pathogens. Several of these are small commercial laboratories that conduct testing primarily for LTCFs and are more available than laboratories with a larger testing volume to collaborate with surveillance coordinators, facilitating active identification of positive cases in LTCF patients.[22]

Novel outbreak identification method

At the beginning of the 2013-2014 influenza season, a list of the 175 nursing homes in the NY Metro—NYC region at the time was obtained from the NYSDOH Website.[23] The addresses of these facilities were geocoded to obtain the BINs.

We performed a building-level automated daily analysis to identify case-patients with laboratory-confirmed influenza in the disease database system whose address or BIN value matched that of a facility. The building analysis consisted of 4 steps: first, all addresses associated with influenza cases in the database system and all facility addresses went through a process to standardize street suffixes, numbers, and cardinal directions and delete ordinal suffixes, punctuation, and apartment or unit information. Second, we identified matching BIN values between the first geocodable residential address received for influenza case-patients in the database and LTCFs.

Third, for addresses with missing or nonmatching BIN values, we performed an approximate text match between influenza case-patient addresses and LTCF addresses using the “compged” function in SAS 9.2 (SAS Institute, Inc, Cary, NC); sample SAS code for this step is provided in the Supplemental Online Appendix. We kept matches with a generalized edit distance, a measure of dissimilarity between 2 strings, of < 200 for manual review. We also required that the first 2 characters of both addresses must be identical. Midway through the 2013-2014 season, when a match was missed because the address in the disease database system included extra characters, we implemented a restriction to use for matching only the first 17 characters of the address text. The approximate text-matching process typically identified matches on case-patients whose addresses did not geocode (eg, because of an incorrect borough value or typographic error in the street name) and so were not assigned a BIN value but were similar to an address on the facility list. Finally, for addresses that were identified neither in the BIN match nor the approximate text match, we performed a keyword search to identify words like *Home*, *Nursi*, *Center*, or *Care* in any address field for a case-patient.

Throughout the 2013-2014 influenza season (September 29, 2013-May 31, 2014[11]), the SAS program described above was set up to run daily on the Task Scheduler (Microsoft, Redmond, Wash) of a computer dedicated to routine automated analyses. The code automatically flagged new matches and appended them to a master list in Excel 2003 (Microsoft). The first date that each match was discovered was recorded, and DOHMH influenza surveillance coordinators regularly inspected this master list of potential matches and decided whether further investigation was warranted for each record.

As a secondary objective, we also performed this analysis for non-Article 28 congregate housing facilities (eg, adult care facilities and assisted living facilities) and homeless shelters. A list of non-Article 28 facilities was obtained from the NYC Department of City Planning,[24] and a list of homeless shelters was obtained from