Assessing the reporting quality of influenza outbreaks in the community

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Background: High-quality reporting of outbreak characteristics is fundamental to understand the behaviour of various strains of influenza virus and the impact of outbreak management strategies. However, few studies have systematically evaluated the quality of outbreak reporting.

Objectives: To conduct a systematic analysis and assessment for reporting quality of influenza outbreaks based on a modified version of the STROBE statement, and to examine characteristics associated with reporting quality.

Methods: A literature search was conducted across 3 online databases (PubMed, Web of Science, MEDLINE) for reports of influenza outbreaks (pandemic H1N1, avian, seasonal). The quality of reports meeting our eligibility criteria was assessed using the Modified STROBE criteria and assigned a score of 30. Mean differences (MD) and 95% confidence intervals (CI) were reported for comparisons of study characteristics.

Results: Sixty-four outbreak reports were available for analyses. The average Modified STROBE score was 20/30. Peer-reviewed articles were associated with a better quality of reporting (MD 2.79, 95% CI 0.79-4.78). Likewise, reports from authors affiliated with public health agencies were associated with better quality than those from academic institutions (MD 1.65, 95% CI -0.27-3.56).

Conclusions: The development of explicit reporting guidelines specifically geared towards reporting of outbreak investigations proved to be useful. Providing information on patient characteristics, investigation details in introduction and results, as well as addressing limitations that could have biased the findings, were frequently missing in the published reports.

Keywords: influenza, outbreaks, reporting criterion, reporting quality, STROBE statement

INTRODUCTION

Influenza causes outbreaks in a broad range of settings including hospitals, schools, long-term care centres and other confined settings.1 Such outbreaks are largely reported in descriptive studies such as case reports and case series, surveillance reports and cross-sectional studies, and guidelines how these should be reported exist.2 Objective documentation of outbreak characteristics (eg, infected individuals, setting, duration of exposures potentially associated with outcomes) serves as the primary basis to understand epidemiological characteristics of various strains of influenza virus, and how outbreaks can potentially be managed.3

For influenza outbreak data to be most informative, it is important that sufficient details are reported, which may be lacking in many...
reports. In fact, few studies have systematically evaluated the quality of outbreak reporting of any type of pathogen. To this end, we sought to conduct a systematic analysis of the quality of reporting of influenza outbreaks and to examine characteristics associated with the quality of reporting.

2 | METHODS

All decisions regarding eligibility criteria, search strategy, study selection, data collection, quality assessment and analysis were established a priori.

2.1 | Eligibility criteria

We included outbreak studies involving human patients only and where the primary outbreak pathogen was either pandemic H1N1, avian or seasonal influenza. However, due to literature including zoonotic diseases (eg, avian influenza), investigations involving animal sources transmitting influenza virus to humans were eligible. We limited reports to those that at least described one or more of the following: onset of outbreak, clinical manifestations, control measures or specific diagnostic testing. Studies that evaluated surveillance systems or developed transmission models were not eligible for inclusion. We also excluded studies that did not provide a descriptive detailed account of individual outbreaks, such as annual surveillance reports.

2.2 | Search strategy and data extraction

We searched PubMed, Web of Science and MEDLINE for reports published from 2000 to October 2015 using a basic combination of keywords and subject headings (Figure 1 and Table S3). Our goal was not to conduct a systematic review of outbreaks but rather to obtain an unbiased sample of more recent influenza outbreaks as a general assessment of its reporting quality. Only English language papers were included.

2.3 | Quality assessment

To capture the key elements of outbreak reporting and enable effective assessment of reporting quality, we made several modifications to the original STROBE (Strengthening the Reporting of Observational Studies in Epidemiology, a 22-item checklist) resulting in a 30-item quality assessment tool (referred to as “Modified STROBE” below; Table 1). These changes were made based on detailed discussion amongst the 3 authors. Two of the authors (DM, ML) have content as well as methodological expertise and experience applying STROBE. With each individual component of the tool worth 1 point, a quality score (“Modified STROBE score”) was computed for each outbreak report with a maximum value of 30. Individual Modified STROBE scores for each report are in Table S1, while Table S2 shows modifications made to the original assessment tool.

2.4 | Predictor variables

A potential association with the quality of reporting (ie, Modified STROBE score) was assessed for 7 variables: publication year, continent of outbreak, influenza strain, outbreak size, outbreak settings, author affiliation (academic institution vs non-academic [eg, public health agencies and authorities]) and publication type (peer-reviewed vs epidemiologic report). The predictor variables were selected a priori. We examined publications prior to and after 2009 on the basis of 2009 H1N1 pandemic given the large number of articles that followed the pandemic. Similarly, we sought to see differences by H1N1 vs seasonal or avian influenza. As STROBE (Strengthening the Reporting of Observational studies in Epidemiology) was developed in North America and Europe, we wanted to assess differences between these and other regions. We included outbreak size to assess differences between small (local teams) vs larger outbreaks that may have national teams involved. We were interested in seeing whether hospital staff fared differently in reporting compared to the community. Along a similar line, we wanted to see whether public health officials reported better/worse compared to academics. We expected better reporting with peer-reviewed publications so aimed to assess this as well.

Covariates with a P-value of <.10 in the univariate analysis were included in the multivariate model. We chose the P < .10 threshold to maintain a balance between screening predictive factors for multivariate analysis but also ensuring adequate exclusion for factors deemed limited correlation with differences in quality scores. All statistical analyses were conducted using SPSS/PASW Version 18 (SPSS Inc., Chicago, IL, USA). In the event that the investigation report involved both academic and public health institutions, the corresponding author of the report was used to determine author affiliation.

3 | RESULTS

A total of 64 of 174 (37%) studies reviewed in full text met our eligibility criteria and underwent assessment for the quality of reporting.

3.1 | Quality assessment

The mean Modified STROBE score of included studies was 20.0 (standard deviation (SD) ± 3.6) of 30. All studies provided scientific background and context to the reported outbreak (Item 2A) and quantitative data on affected patients/reported outbreaks (2C) (Table 1). Similarly, more than 90% of the reports included an informative summary (1C), elements of study design (3A), motivations behind reporting (3B), breakdown of study size (3M), clinical significance (5A) and external validity of results (5C). In terms of poorly reported elements, the 3 items least frequently reported were 3N (addressing missing data), 3O (sensitivity analysis) and 4E (provision of risk estimates, odds ratio) at 5%, 0% and 25% of studies, respectively (Table 1). Sensitivity analyses and reporting of risk estimates were not necessarily appropriate for all studies, which explains to a large extent as to why these criteria were only met in a small minority of reports.
3.2 | Factors associated with better reporting

Of the 64 available reports, 51 (80%) were published from 2009 and after. These reports had significantly higher Modified STROBE scores than those published prior to 2009 (MD 3.43, 95% CI 0.86 to 6.00, \( P = .010 \)). Forty-nine reports (77%) were peer-reviewed publications. We found significantly higher scores with reports published in peer-reviewed journals as opposed to public health epidemiologic reports (MD 2.79, 95% CI 0.79-4.78, \( P = .007 \)). The remaining 5 predictors were not found to be significantly predictive for higher Modified STROBE scores (Table 2).

In the multivariate model, only 4 covariates were retained as per our analysis plan: publication type, author affiliation, publication year and outbreak size. Peer-reviewed journals \( (P = .034) \) remained a significant predictor for higher Modified STROBE scores. While not associated with reporting quality in univariate analysis, affiliation with public health institutions \( (P = .035) \) was associated with significantly higher scores in the multivariate analysis. Meanwhile, the quality of reports published after 2009 was no longer significantly better than the quality of older reports \( (P = .076) \).

4 | DISCUSSION

On average, the 64 influenza outbreak reports assessed in this study met two-thirds of the quality criteria in our Modified STROBE assessment tool. In multivariate analysis, significantly higher Modified STROBE scores were noted for peer-reviewed articles compared to epidemiologic reports and for those written by public health-affiliated authors compared to academic institutions.
One possible explanation for higher STROBE scores in peer-reviewed articles was that outbreaks with significant health impact (e.g., 2009 H1N1 influenza pandemic affecting several countries and spanned over months) received greater attention and were reported in higher-impact journals that would typically put more emphasis on appropriate reporting. This is in contrast to, for example, a school-based outbreak that spanned several days and then posted in an epidemiologic journal as a brief weekly update. Higher STROBE scores in peer-reviewed articles may also have been the direct result of peer review, that is, improvement in the article following the initial review.

Reports by public health-affiliated authors were superior in quality to those from academic institutions when included in our multivariate

| Modified STROBE Component | Component Description                                                                 | n (%) Accurately Reported |
|---------------------------|--------------------------------------------------------------------------------------|---------------------------|
| 1) Title and Abstract     | a) Either title, abstract or both sections clearly indicated study design.             | 39 (61)                   |
|                           | b) Study’s focus and investigation details within title, abstract or both sections (e.g., Influenza subtype, Geographic Location, Setting) were clearly elicited | 39 (61)                   |
|                           | c) Informative summary provided in the abstract discussing steps taken along with investigation findings | 63 (98)                   |
| 2) Introduction           | a) Scientific background, evidence and rationale provided for reporting and conducting investigation | 64 (100)                  |
|                           | b) Specific objectives for study stated, include pre-established hypotheses if applicable | 57 (89)                   |
|                           | c) Specific quantities provided: for example number of outbreak(s)/communities reported, number of patients from influenza outbreak (suspected, confirmed, total, etc.) | 64 (100)                  |
|                           | d) A timeline of the study was provided: includes start/finish dates of conducted investigation or outbreak | 31 (48)                   |
| 3) Methods                | a) Present key elements of study design early in report                               | 61 (95)                   |
|                           | b) Was decision to report prompted by any outcome data?                               | 62 (97)                   |
| Outbreak characteristics  | c) Number of patients admitted during outbreak                                         | 43 (67)                   |
|                           | d) Distributions provided for patient demographics                                     | 38 (59)                   |
|                           | e) Proportion admitted from other hospitals, wards, communities, etc.                  | 26 (41)                   |
|                           | f) Potential risk factors for acquiring organism included                               | 46 (72)                   |
|                           | g) Case definitions for outbreaks were included                                        | 54 (84)                   |
|                           | h) Proportions of patient outcomes were included (e.g., ICU, hospitalization, mortality) | 49 (77)                   |
| Outbreak location/settling | i) Description of unit, hospital, community.                                            | 29 (45)                   |
| Organization of patient and sample data | j) Provide eligibility criteria for selection of cases, participants and/or controls (more for cohort/case-control) | 54 (84)                   |
|                           | k) Provide number of exposed/unexposed (cohort) or controls per case (case-control)    | 19 (30)                   |
|                           | l) Describe any efforts to address potential sources of bias                           | 17 (27)                   |
|                           | m) Explain how the final study size was arrived at (or patient/case count)             | 62 (97)                   |
|                           | n) Explain how missing data were addressed                                             | 3 (5)                    |
|                           | o) Describe any sensitivity analysis                                                  | 0 (0)                    |
| 4) Results                | a) Consider use of a flow diagram to depict patient or participant count at each stage of investigation | 52 (81)                   |
|                           | b) Descriptive                                                                         | 53 (83)                   |
|                           | Give characteristics of study participants (e.g., demographic, clinical, social) + information on exposures and any other associative factors |                      |
|                           | c) Timeline: charts to display duration of patient stay, date of detecting organisms, etc. | 28 (44)                   |
|                           | d) Consideration of any confounding variables (e.g., use of antibiotics, length of stay changes) | 47 (73)                   |
|                           | e) Further results and analyses                                                        | (25)                     |
|                           | If applicable, provided unadjusted and confounder-adjusted estimates with confidence intervals. |              |
| 5) Discussion             | a) Clinical signification of observations was considered and hypotheses were reviewed in relation to the findings. | 63 (98)                   |
|                           | b) Discuss limitations of study, accounting for any potential bias.                    | 43 (67)                   |
|                           | c) Discussed generalizability (external validity) of findings and applicability with current evidence | 59 (92)                   |
analysis, but not when assessed as an independent predictor. Although we referred to corresponding author’s affiliation if an article had both academic and public health institutions, extensive resources for outbreak reporting and epidemiologic guidelines are likely to be consulted amongst authors regardless of institutional affiliation. With respect to our multivariate results, significantly greater scores could be related to the fact that >80% of our reports (53/64) involved help from public health authorities (local or international). Experts from these organizations are well versed in surveillance standards established by their affiliated organizations, for instance with extensive guidelines detailing the core concepts of surveillance systems and strategies to devise effective documentation of outbreak patterns.

The quality of reports that have been published since 2009 was found to be higher compared to older reports in univariate, but not in the multivariate analysis. This may be related to the fact that our sample of publications since 2009 was more likely to be reported in peer-reviewed journals (46/56 reports, 82%) and involving investigators with public health affiliation (39/56, 70%). It is likely that this was an important source of confounding which was subsequently accounted for in our multivariate analysis. Furthermore, standardized methodology for transparent reporting has been available for outbreaks report and similar epidemiologic studies (eg, STROBE, ORION) prior to 2009.

A possible explanation for similar scores in different geographic regions could be that there were no clear differences in terms of reporting protocol across international settings. Even for outbreaks outside of North America and Europe, investigators could have originated or trained from similar public health organizations (eg, WHO, CDC) and hence proceed the investigation with limited deviations to their guidelines regardless of location. This is supported by several publications in the “non-North American, non-European” group which involved institutions such as WHO and CDC. Despite the equal proportion of outbreak reports in North America/Europe vs other continents, non-representative sampling may also have played a role given that “Other continents” group was mainly represented by Asian countries (69% of the 32 reports), suggesting a relative lack of publication from other continents.

Strengths of this review included a comprehensive search strategy, along with the incorporation of assessment criteria based on established grading tools for observational studies. We believe that our tool may be applicable to outbreaks of other respiratory viruses and pathogens. Further applications of our modified assessment tool will help determine its generalizability to other pathogens and outbreak settings as the scope of this study was limited to influenza outbreaks that were reported in English and may not be a collective representation of outbreak populations. Furthermore, our a priori criterion for differentiating affiliation (based on first/corresponding author) may not be exact enough in defining publications where authors were affiliated with both academic and public health institutions, and hence mutual exclusivity between comparison groups could not be established; this was supported by 8 of 19 publications in our “academic institution” group. The modification to the STROBE instrument was performed internally, and there was no involvement of representatives of public health agencies or any other stakeholders. This will be considered as a next step to further strengthen the instrument for future use. We also acknowledge that our modification to STROBE was based on face validity, and we did not conduct inter-rater reliability or formal validation studies.

In conclusion, development of explicit reporting guidelines specifically geared towards publication of outbreak investigations might be useful, given there were low to moderate (<70%) rates of reports providing information on patient characteristics, investigation

### Table 2: Predictors for reporting quality univariate and multivariate analysis

| Predictor Variables | Comparison Groups | Modified STROBE Mean Score (SD) | Mean Difference (95% CI) | P-values (Univariate Analysis) | P-values (Multivariate Analysis) |
|---------------------|------------------|--------------------------------|--------------------------|-------------------------------|---------------------------------|
| Publication year    | 2009+            | 20.43 (3.27)                  | 3.43 (0.86 to 6.00)      | .010                          | .076                            |
|                     | 2009-            | 17.00 (4.28)                  |                          |                               |                                 |
| Journal type        | Peer-reviewed    | 20.65 (3.23)                  | 2.79 (0.79 to 4.78)      | .007                          | .034                            |
|                     | Epidemiologic Report | 17.87 (3.85)             |                          |                               |                                 |
| Affiliation         | Public Health    | 20.49 (3.62)                  | 1.65 (−0.27 to 3.56)     | .091                          | .035                            |
|                     | Academic Institution | 18.84 (3.20)              |                          |                               |                                 |
| Outbreak size       | By increase of 10 patients | 20.00 (3.56)            | n/a                      | .085                          | .244                            |
| Outbreak location (Continent) | North America, Europe | 19.97 (3.48)          | −0.06 (−1.86 to 1.73)    | .945                          | -                               |
|                     | Africa, Asia, South America, Oceania | 20.03 (3.69)       |                          |                               |                                 |
| Influenza strain    | H1N1             | 20.44 (3.13)                  | 1.49 (−0.76 to 3.75)     | .184                          | -                               |
|                     | Avian, Seasonal  | 18.95 (4.33)                  |                          |                               |                                 |
| Outbreak setting    | Hospital         | 20.78 (3.26)                  | 1.08 (−0.89 to 3.06)     | .278                          | -                               |
|                     | Community        | 19.70 (3.66)                  |                          |                               |                                 |

CI, confidence intervals; SD, standard deviation; -, not applicable.
details in crucial parts of the report (eg, abstract/introduction, results) and in addressing limitations that could bias findings. If appropriately reported, evidence from outbreak reports can help in the management of similar outbreaks in the future and are as such an important tool for public health officials, hospital epidemiologists and other health professionals managing outbreaks.

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AUTHOR'S CONTRIBUTION

CKL, ML and DM drafted the protocol and collaboratively made modifications to the assessment tool (Modified STROBE). CKL conducted the literature search, reviewed articles for eligibility and computed individual scores for each report. All authors contributing to reviewing and finalizing specific components of the aforementioned steps. CKL conducted the data analysis and interpretation. DM and ML provided feedback on the interpretation of data. CKL, DM and ML drafted the manuscript. All authors critically reviewed the manuscript content and provided final approval of the version to publish.

CONFLICT OF INTEREST

The authors have no competing interests.

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REFERENCES

1. Who.int. WHO | Influenza (Seasonal). 2014 [cited 16 March 2016]. Available from: http://www.who.int/mediacentre/factsheets/fs211/en/
2. Stone S, Cooper B, Kibbler C, et al. The ORION statement: a CONSORT equivalent for infection control studies- Guidelines for transparent reporting of Outbreak Reports and Intervention studies Of Nosocomial infection. J Infect. 2007;55:e89.
3. Grimes D, Schulz K. Descriptive studies: what they can and cannot do. The Lancet. 2002;359:145-149.
4. Pocock SJ, Collier TJ, Dandreo KJ, et al. Issues in the reporting of epidemiological studies: a survey of recent practice. BMJ. 2004;329:883.
5. Tooth L, Ware R, Bain C, Purdie DM, Dobson A. Quality of reporting of observational longitudinal research. Am J Epidemiol. 2005;161:280-288.
6. Cooper BS, Stone SP, Kibbler CC, et al. Systematic review of isolation policies in the hospital management of methicillin resistant Staphylococcus aureus: a review of the literature with epidemiological and economic modelling. Health Technol Assess. 2003;7:1-194.
7. Cooper BS, Stone SP, Kibbler CC, et al. Isolation measures in the hospital management of MRSA: a systematic review of the literature. BMJ. 2004;329:533-538.
8. Ramsay C, Brown E, Hartman G, Davey P. Room for improvement: a systematic review of the quality of evaluations of interventions to improve hospital antibiotic prescribing. J Antimicrob Chemother. 2003;52:764-771.
9. Davey P, Brown E, Fenelon L, et al. Interventions to improve antibiotic prescribing practices for hospital inpatients. Cochrane Database Syst Rev. 2005;4:CD003543.
10. van Elm E, Altman D, Egger M, Pocock S, Vandenbroucke J. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies. Int J Surg. 2014;12:1495-1499.
11. Apisarnthanarak A, Mundy LM. Outbreak of influenza A (2009) H1N1 among Thai healthcare workers: is it time to integrate a vaccination program? Infect Control Hosp Epidemiol. 2010;31:854-856.
12. Areechokchai D, Jiraphongs A, Laosiritaworn Y, Hanshaoworakul W, O'Reilly M. Centers for Disease Control and Prevention, et al. Investigation of avian influenza (H5N1) outbreak in humans–Thailand, 2004. MMWR Suppl. 2006;55(Suppl 1):3-6.
13. Asiedu-Bekoe F, Adu DA, Ofei A, Mass osetamivir prophylaxis halts pandemic influenza A H1N1 2009 outbreak in a secondary school in Ashanti Region, Ghana. Ghana Med J. 2012;46:219-224.
14. Balicer RD, Huerta M, Levy Y, Davidovitch N, Grotto I. Influenza outbreak control in confined settings. Emerg Infect Dis. 2005;11:579-583.
15. Balicer RD, Reznikovich S, Berman E, et al. Multifocal avian influenza (H5N1) outbreak. Emerg Infect Dis. 2007;13:1601-1603.
16. Bearden A, Friedrich TC, Goldberg TL, et al. An outbreak of the 2009 influenza a (H1N1) virus in a children’s hospital. Influenza Other Respir Viruses. 2012;6:374-379.
17. Biswas DK, Kaur P, Murhekar M, Bhunia R. An outbreak of pandemic influenza A (H1N1) in Kolkata, West Bengal, India, 2010. Indian J Med Res. 2012;135:529-533.
18. Bradley-Stewart A, Miller RS, Maclean A, et al. Cluster of influenza A cases in vaccinated population of adults in Virology Laboratory in Glasgow in December 2012. Scott Med J. 2014;59:95-102.
19. Camagnolo ER, Moll ME, Tuhecak K, et al. Concurrent 2009 pandemic influenza A (H1N1) virus infection in ferrets and in a community in Pennsylvania. Zoonoses Public Health. 2013;60:117-124.
20. Centers for Disease Control and Prevention. Notes from the field: outbreak of influenza A(H3N2) virus among persons and swine at a county fair–Indiana, July 2012. MMWR Morb Mortal Wkly Rep. 2012;61:561.
21. Centers for Disease Control and Prevention. Influenza outbreaks at two correctional facilities – Maine, March 2011. MMWR Morb Mortal Wkly Rep. 2012;61:229-232.
22. Centers for Disease Control and Prevention. Severe influenza among children and young adults with neurologic and neurodevelopmental conditions - Ohio, 2011. MMWR Morb Mortal Wkly Rep. 2012;60:1729-1733.
23. Centers for Disease Contron and Prevention. Outbreak of 2009 pandemic influenza A (H1N1) on a Peruvian Navy ship - June-July 2009. MMWR Morb Mortal Wkly Rep. 2010;59:162-165.
24. Centers for DiseaseControl and Prevention. Outbreak of 2009 pandemic influenza A (H1N1) at a school - Hawaii, May 2009. MMWR Morb Mortal Wkly Rep. 2010;58:1440-1444.
25. Centers for Disease Control and Prevention. Outbreak of swine-origin influenza A (H1N1) virus infection - Mexico, March-April 2009. MMWR Morb Mortal Wkly Rep. 2009;58:467-470.
26. Centers for Disease Control and Prevention. Swine-origin influenza A (H1N1) virus infections in a school - New York City, April 2009. MMWR Morb Mortal Wkly Rep. 2009;58:470-472.
27. Centers for DiseaseControl and Prevention. Influenza outbreak –Madagascar. July-August 2002. MMWR Morb Mortal Wkly Rep. 2002;51:1016-1018.
28. Centers for Disease Control and Prevention. Influenza B virus outbreak on a cruise ship–Northern Europe, 2000. MMWR Morb Mortal Wkly Rep. 2001;50:137-140.
29. Chen LF, Dailey NJ, Rao AK, et al. Cluster of oseltamivir-resistant 2009 pandemic influenza A (H1N1) virus infections on a hospital ward among immunocompromised patients—North Carolina, 2009. J Infect Dis. 2011;203:838-846.

30. Cosby MT, Pimentel G, Nevin RL, et al. Outbreak of H3N2 influenza at a US military base in Djibouti during the H1N1 pandemic of 2009. PLoS One. 2013;8:e82089.

31. Cui F, Luo H, Zhou L, et al. Transmission of pandemic influenza A (H1N1) virus in a train in China. J Epidemiol. 2011;21:271-277.

32. Cutler J, Schleienhaus E, Hatchette TF, et al. Investigation of the first cases of human-to-human infection with the new swine-origin influenza A (H1N1) virus in Canada. CMAJ. 2009;181:159-163.

33. Dawood FS, Dong L, Liu F, et al. A pre-pandemic outbreak of triple-reassortant swine influenza virus infection among university students, South Dakota, 2008. J Infect Dis. 2011;204:1165-1171.

34. Del Bianco R, Santos MS, Ribeiro MC, Viso AT, Carvalho V. Clinical aspects of influenza A (H1N1) in HIV-infected individuals in Sao Paulo during the pandemic of 2009. Braz J Infect Dis. 2011;15:170-173.

35. Ekaza E, Kajiro H, Coulibaly D, et al. Investigation of an outbreak of acute respiratory disease in cote d’ivoire in April 2007. Afr J Infect Dis. 2014;8:31-35.

36. Fernandes EG, de Souza PB, de Oliveira ME, et al. Influenza B Outbreak on a Cruise Ship off The Sao Paulo Coast, Brazil. J Travel Med. 2014;21:298-303. Web. 19 Apr. 2017.

37. France AM, Jackson M, Schrag S, et al. Household transmission of 2009 influenza A (H1N1) virus after a school-based outbreak in New York City, April-May 2009. J Infect Dis. 2010;201:984-992.

38. Fry AM, Hancock K, Patel M, et al. The first cases of 2009 pandemic influenza A (H1N1) virus infection in the United States: a serologic investigation demonstrating early transmission. Influenza Other Respir Viruses. 2012;6:e48-e53.

39. Gilsdorf A, Boxall N, Gasimov V, et al. Two clusters of human infection with influenza A/H5N1 virus in the Republic of Azerbaijan, February-March 2006. Euro Surveill. 2006;11:122-126.

40. Gong Z, Lv H, Ding H, et al. Epidemiology of the avian influenza A (H7N9) outbreak in Zhejiang Province, China. BMC Infect Dis. 2014;14:244.

41. Grund S, Roggendorf M, Schweiger B. Outbreak of influenza virus A/H1N1 in a hospital ward for immunocompromised patients. Adv Virol. 2010;155:1797-1802.

42. Gu Y, Komiya N, Kamiya H, Yasui Y, Taniguchi K, Okabe N. Pandemic influenza A (H1N1) virus transmission during asymptomatic phase, Japan. Emerg Infect Dis. 2011;17:1737-1739.

43. Gurav YK, Pawar SD, Chadha MS, et al. Pandemic influenza A(H1N1) 2009 outbreak in a residential school at Panchgani, Maharashtra, India. Indian J Med Res. 2010;132:67-71.

44. Hual Y, Lin J, Varma JK, et al. A primary school outbreak of pandemic 2009 influenza A (H1N1) in China. Influenza Other Respir Viruses. 2010;4:259-266.

45. Iuliano AD, Reed C, Guh A, et al. Notes from the field: outbreak of 2009 pandemic influenza A (H1N1) virus at a large public university in Delaware, April-May 2009. Clin Infect Dis. 2009;49:1811-1820.

46. Khaokham CB, Selent M, Loustalot FV, et al. Seroepidemiologic investigation of an outbreak of pandemic influenza A H1N1 2009 aboard a US Navy vessel–San Diego, 2009. Influenza Other Respir Viruses. 2013;7:791-798.

47. Ko JH, Kim JH, Kang JH, et al. Characteristics of hospitalized children with 2009 pandemic influenza A (H1N1): a multicenter study in Korea. J Korean Med Sci. 2012;27:408-415.

48. Koopmans M, Wilibrink B, Conyn M, et al. Transmission of H7N7 avian influenza A virus to human beings during a large outbreak in commercial poultry farms in the Netherlands. Lancet. 2004;363:587-593.

49. Kushwaha AS, Teli P, Mahen A. Outbreak of Influenza (H1N1) amongst children in a residential school. Med J Armed Forces India. 2014;70:274-276.

50. Kwan-Getts TS, Baer A, Duchi J, Spring 2009 H1N1 influenza outbreak in King County, Washington. Disaster Med Public Health Prep. 2009;3(Suppl 2):S109-S116.

51. Lessler J, Reich NG, Cummings DA, et al. Outbreak of 2009 pandemic influenza A (H1N1) at a New York City school. N Engl J Med. 2009;361:2628-2636.

52. Leung YH, Li MP, Chuang SK. A school outbreak of pandemic (H1N1) 2009 infection: assessment of secondary household transmission and the protective role of oseltamivir. Epidemiol Infect. 2011;139:41-44.

53. Li T, Liu Y, Di B, et al. Epidemiological investigation of an outbreak of pandemic influenza A (H1N1) 2009 in a boarding school: serological analysis of 1570 cases. J Clin Virol. 2011;50:235-239.

54. Liu W, Li Z, Tang F, et al. Mixed infections of pandemic H1N1 and seasonal H3N2 viruses in 1 outbreak. Clin Infect Dis. 2010;50:1359-1365.

55. Magill SS, Black SR, Wise ME, et al. Investigation of an outbreak of 2009 pandemic influenza A virus (H1N1) infections among healthcare personnel in a Chicago hospital. Infect Control Hosp Epidemiol. 2011;32:611-615.

56. Mahato RK, Bhandari GP, Shrestha JM, Basnet P. Pandemic Influenza A (H1N1) 2009 outbreak investigation in Nepal. J Nepal Health Res Counc. 2010;8:75-77.

57. Marchbanks TL, Bhattachari A, Fagan RP, et al. An outbreak of 2009 pandemic influenza A (H1N1) virus infection in an elementary school in Pennsylvania. Clin Infect Dis. 2011;52(Suppl 1):S154-S160.

58. Mladenovic J, Cekanac R, Lazic S, et al. Pandemic influenza H1N1 outbreak in the military school. Vojnosanit Pregl. 2013;70:580-585.

59. Morgan OW, Parks S, Shim T, et al. Household transmission of pandemic (H1N1) 2009, San Antonio, Texas, USA, April-May 2009. Emerg Infect Dis. 2010;16:631-637.

60. Pagani L, Thomas Y, Huttner B, et al. Transmission and effect of multiple clusters of seasonal influenza in a Swiss geriatric hospital. J Am Geriatr Soc. 2015;63:739-744.

61. Peter S, Balakrishnan A, Potdar VA, Chadha MS, Jadhav SM. An outbreak of influenza A (H3N2) in Alappuzha district, Kerala, India, in 2011. J Infect Dev Cent. 2015;9:362-367.

62. Pollara CP, Piccinelli G, Rossi G, et al. Nosocomial outbreak of the pandemic Influenza A (H1N1) 2009 in critical hematologic patients during seasonal influenza 2010-2011: detection of oseltamivir resistant variant viruses. BMC Infect Dis. 2013;13:127.

63. Pollock SL, Sagan M, Oakley L, Fontaine J, Poffenroth L. Investigation of a pandemic H1N1 influenza outbreak in a remote First Nations community in northern Manitoba, 2009. Can J Public Health. 2012;103:90-93.

64. Rajatonirina S, Heraud JM, Randrianasolo L, et al. Pandemic influenza A(H1N1) 2009 virus outbreak among boarding school pupils in Madagascar: compliance and adverse effects of prophylactic oseltamivir treatment. J Infect Dev Cent. 2011;5:156-162.

65. Tanner HE, Curran MD, Boxall EH, Osman H. Viral respiratory infections during the 2009 influenza A(H1N1) outbreak in the West Midlands Region, UK. Epidemiol Infect. 2012;140:1551-1556.

66. Tarabbo M, Lapa D, Castilletti C, et al. Retrospective investigation of an influenza A/H1N1pdm outbreak in an Italian military ship cruising in the Mediterranean Sea, May-September 2009. PLoS One. 2011;6:e15933.

67. Tsagris V, Nika A, Kyriakou D, et al. Influenza A(H1N1)2009 virus outbreak among boarding school pupils in Taiwan: clinical and virological assessment. Clin Infect Dis. 2009;49:1595-1600.

68. Wane J, Nyatanyi T, Nkunda R, et al. 2009 pandemic influenza A (H1N1) virus outbreak and response–Rwanda, October 2009-May, 2010. PLoS One. 2012;7:e31572.

69. Wiktor CP, Duffy MR, Macias EA, et al. (H1N1)1 outbreak at the U.S. Air Force Academy: epidemiology and viral shedding duration. Am J Prev Med. 2010;38:121-126.
71. Wong BC, Lee N, Li Y, et al. Possible role of aerosol transmission in a hospital outbreak of influenza. Clin Infect Dis. 2010;51:1176-1183.
72. Yamagishi T, Matsui T, Nakamura N, et al. Onset and duration of symptoms and timing of disease transmission of 2009 influenza A (H1N1) in an outbreak in Fukuoka, Japan, June 2009. Jpn J Infect Dis. 2010;63:327-331.
73. Yan L, Gao Y, Zhang Y, et al. Epidemiological and virological characteristics of pandemic influenza A (H1N1) school outbreaks in China in 2009. PLoS One. 2012;7:e45898.
74. Young LC, Dwyer DE, Harris M, et al. Summer outbreak of respiratory disease in an Australian prison due to an influenza A/Fujian/411/2002(H3N2)-like virus. Epidemiol Infect. 2005;133:107-112.
75. WHO. Communicable disease surveillance and response systems: Guide to monitoring and evaluating; 2006 [cited 24 March 2016]. Available from: http://www.who.int/csr/resources/publications/surveillance/WHO_CDS_EPR_LYO_2006_2.pdf
76. Vandenbroucke J, von Elm E, Altman D, et al. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): explanation and Elaboration. PLoS Med. 2007;4:e297.

SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

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