Original Research Article

Trends of seasonal influenza incidence among the population of Abha, Saudi Arabia during 2019

Abstract

Background: Influenza infection occurs in seasonal pattern and leads to an extensive burden of disease. The surveillance system can reduce the threat to public health posed by influenza through providing timely and high-quality epidemiological data to reduce the impact of illness and to inform public health authorities in their appropriate response to this disease.

Objective: To assess the incidence of seasonal influenza in Abha City, Saudi Arabia

Methods: This surveillance report conducted among citizens of Abha, Saudi Arabia, 2019. It is based on sentinel surveillance and case-based data collection of laboratory-confirmed cases through electronic health records. All data were obtained from the department of infectious diseases of public health department in Aseer health directorate.

Results: The total reported positive cases for influenza viruses were 808 (22.30%) patients in the city of Abha for the year 2019, among them 435 males and 373 females (F= 9.5149; P=0.002038) which 665 (82.3%) were typed as influenza A and 143 (17.7%) as influenza B. (F= 674.46; P=0.001). The disease was most commonly seen in the age group of 5-15 (42.35 %) with a mean age of 15.45±4.50 followed by 16 to 50 years age (37.45%) and 51-65 age group (10%). There was no death registered among these cases. The positivity rates were highest in February and lowest in July and June month. The influenza positivity rate showed one primary peak and three secondary peaks, which occurred in February and January, March and December.

Conclusion: The importance of conducting effective epidemiological surveillance for influenza virus in various regions in Abha specially in winter season with a peak in the month of February.

Keywords: Seasonal Influenza, Incidence, Endemic, Public health, Influenza vaccine

Introduction

Seasonal influenza is an acute respiratory infection caused by influenza viruses which are highly contagious and circulate in all parts of the world. It gives rise to an estimated 3 to 5 million cases of severe illness and about 250,000 to 500,000 deaths globally each year [1]. Although A, B, and C types of influenza exist, type C is detected much less frequently than the other two types and tends to cause only mild infection in humans [1]. In contrast, both A and B types cause outbreaks and epidemics; according to the World Health Organization (WHO), the H1N1 (A (H1N1) pdm09) and H3N2 subtypes and B/Yamagata and B/Victoria were the subtypes of Influenza virus A and B respectively which are currently circulating among humans. Given its geographic location and large

population, the Gulf Region is an important region for influenza circulation annually.

In Saudi Arabia, millions of Muslims from all over the world visit the holy cities of Makkah and Madinah for Omrah and Hajj all over the year. This massive congregation of people can potentially increase the risk of spreading and acquiring respiratory pathogens among pilgrims and visitor, which raises global and public health concerns due to the high potential of international spread of such pathogens [2]. Furthermore, there is a great diversity of inbound viruses from around the world that can potentially spread among the immunologically naive hosts. Therefore, acute respiratory infections are very common during Hajj and most commonly isolated viruses from symptomatic patients during Hajj season were human rhinoviruses (hRVs), influenza virus and novel Middle East respiratory syndrome coronavirus (MERS-CoV) in Saudi Arabia, known for its endemicity, and high mortality (35%-40%) [3]. The Saudi Ministry of Health (MOH) provides inactivated influenza vaccinations annually and free of charge to anyone over the age of six months and encourages to vaccination among many promotional ways to increase the vaccine uptake rates [4]. The importance of the annual influenza vaccination is highlighted in different media outlets and healthcare centers as well as on the website of the Saudi Ministry of Health, especially prior to the annual pilgrimage season [5]. Their overall efforts have resulted in in a progressive increment in vaccination coverage with the coverage rate of 17.8% in 2009 to 44.5% in 2018 [4,6].

Abha is the largest city in Asir region. It is located in the southwest of Saudi Arabia, covering an area of more than 80 000 km^2. The region extends from the high mountains of Sarawat (3200 m above sea level) to the Red Sea and lies a few kilometers from the northern border of Yemen. It is the capital city for tourism in the Gulf area, its climate, location and beautiful nature are the most common factors that attract thousand hundreds of tourism each year. The region is divided into 15 health districts [7]. The previous reports from this region observed the presence of Human respiratory syncytial virus (HRSV), Human metapneumovirus and Human adenoviruses (HAdVs) amongst the children suffering from respiratory tract infections [8]. However, little has been observed regarding the presence of influenza in this region. Hence the present study aimed to investigated trends of seasonal influenza incidence in the city of Abha during 2019.

Material and methods

We undertook a descriptive, surveillance system based cross-sectional study. All available and related data from the Health Electronic Surveillance Network (HESN) and Influenza surveillance system (ISS) of Abha City for the year 2019 were obtained. A formal consent

from the supervisor of these systems was done. The operational definition of seasonal influenza cases in our study was based on the following; clinically diagnosed Influenza-like Illness (ILI), laboratory-confirmed influenza A (including critically ill patients) and lab-confirmed cases through HESN. Extensively, all the following: ILI, ARI, laboratory-confirmed influenza cases through (RT-PCR, Viral Culture or four-fold rise in influenza virus-specific neutralizing antibodies) and severe acute respiratory infection (SARI). ILI was defined as an acute respiratory illness with onset during the last 7 days with measured temperature $\geq 38°$ and cough. ARI was defined as an acute onset of at least one of the following four respiratory symptoms: cough, sore throat, shortness of breath, coryza and a clinician's judgment that the illness was due to an infection. ARI may present with or without fever. HESN considers all ILI and ARI was carried out throughout the calendar year and the weekly monitoring and reporting to (MOH) is carried out during the entire year.

General practitioners, emergency department physicians and pediatricians in all primary healthcare centers and hospitals in Abha were employed to report ILI and ARI cases through electronic registration (HESN). This information was aggregated in the central database of the department of infectious diseases of Public Health in Abha city. Data were cleaned, synthesized, imported and combined in a MS Excel sheet for analysis. The number of positive cases for Influenza in the year 2019 and percentage was revealed and compared based on age, gender, Influenza virus Type and seasonal variation using descriptive analysis.

Statistical Analysis:

We used the Edwards harmonic technique method to measure the peak-to-low ratio [9]. The Edwards technique is a geometrical model, which is an approach that fits a sine curve to a time series of frequencies by the use of ordinary regression methods. The peak-to-low ratio was interpreted as a measure of relative risk that compares the month with the highest incidence (peak) with the month with the lowest incidence (low or trough). The positivity rates for influenza virus during the discrete peak and low periods were compared using a direct method (χ2-test) to analyze statistical significance. Categorical variables like gender and age group distribution are presented as numbers and percentages. p-values were calculated using the chi-square test, and a p-value of <0.05 was considered to indicate significance and were performed with SPSS version 23.0 (SPSS Inc., Chicago, IL, USA).

Results

Among the visitors of healthcare facilities in Abha for the year 2019, The regional laboratory tested more than 3623 specimens during that period. 808 cases were positive for influenza viruses (Table 1) among them males (435) were significantly more affected than females (373) [F= 9.5149; P=0.002038]

The disease was significantly seen in the adolsence age group of 5-15 (42.35 %) with a mean age of 15.45±4.50 (95% CI) followed by 16 to 50 years age (37.45%) and 51 – 65 age group (10%)(F= 6.097 ; p<0.01) (Figure 2).

Table 1. Positive Cases for Influenza in the year 2019

Positive cases	808(22.30%)		
	Males	Females	P value (Chi Square)
	435(53.83%)	373(46.16%)	0.00203

Influenza type A were present in 665 (82.3%) individuals as compared to influenza type B in 143 (17.7%) [F= 674.46; P=0.001] as the data collected from electronic or actually monitored through hospitals and primary health care centers for which alaboratory examination was performed. There was no death registered among these cases (Table 2).

Table 2. Positive Cases according to type of Influenza in the year 2019

Positive cases	808(22.30%)		
	Influenza A	Influenza B	P value (Chi Square)
	665(82.3%)	143(17.7%)	0.0010

The number of specimens and the positivity rate of Influenza viruses statistically increased in the winter season than compared to other seasons (F= 7.845 ; p<0.05) (Figure 1). The positivity rates were statistically higher in the month of February and lowest in July and June month.(Hajj Period).(F=13.560 ; p<0.05) .The influenza positivity rate showed one peak and three secondary peaks, which occurred in February and January, March and December (Figure 1). Influenza Type A was the most common subtype of influenza and was detected throughout the year. The peak- to- low ratio of this viruses was 1.78 (95% CI: 1.34- 2.29) showed significant seasonality ($P < 0.01$) i.e influenza A virus has a notable risk in and showed seasonal behavior . The number of Positive cases were large enough to evaluate the associated seasonality. The peak- to- low ratio of seasonal influenza was 3.15 (95% CI: 1.56- 3.38) and it had significant seasonality ($P < 0.01$).i.e seasonal influenza has notable risk in the February month and showed seasonal behavior

Figure 1: Positive Influenza Laboratory reported to the department of infectious diseases of Public Health in Abha in 2019

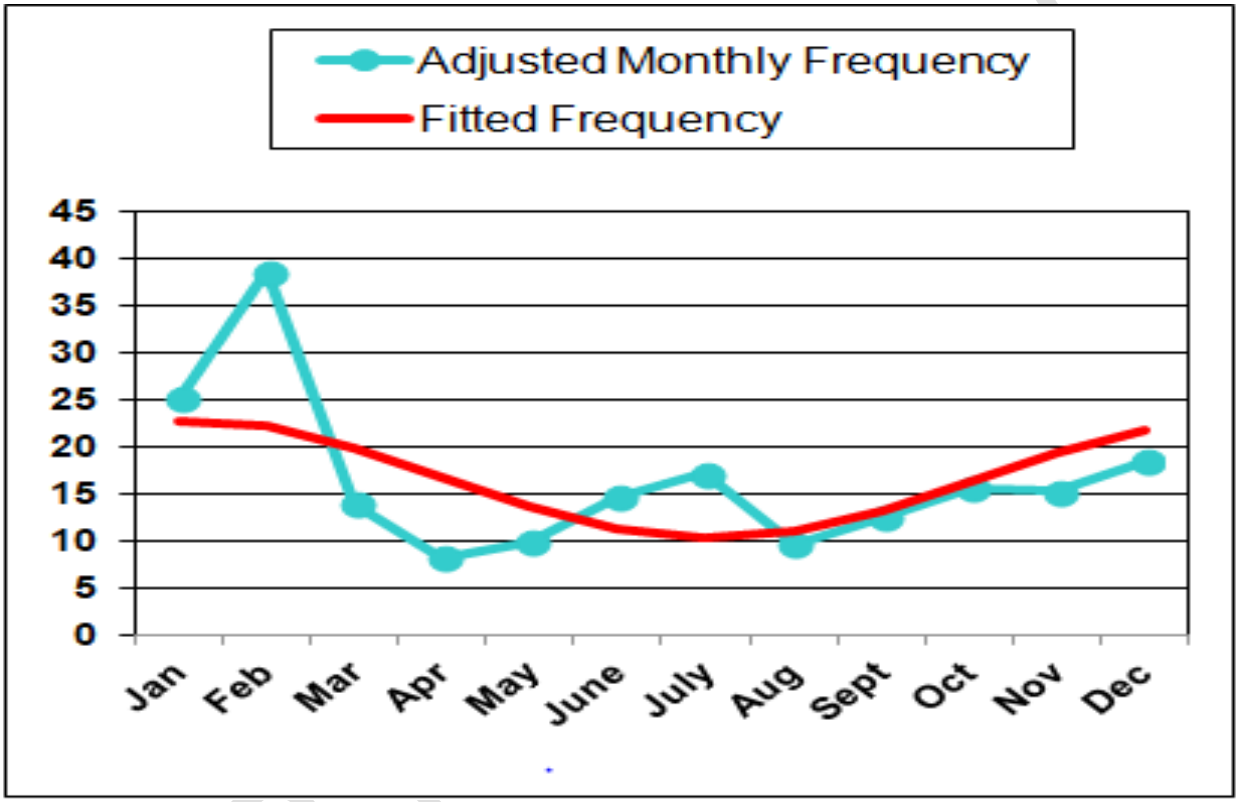
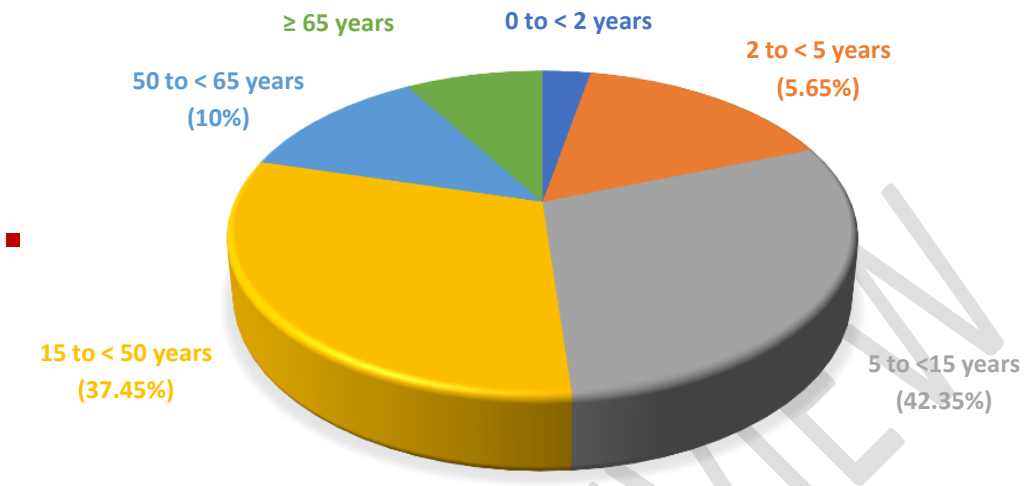


Figure 2: Patients with lab-confirmed influenza reported by age group in Abha, 2019



Discussion

In our study we reported higher prevalence of Influenza virus type A and was the most common subtype detected throughout the year. Our findings were in accordance with a recent systematic review and metanalysis [10] wherein the authors reported an overall influenza virus prevalence of 10.2% pooled from the studies from 17 countries in the middle east region including Saudi Arabia [11-15] and majority of them belongs to virus subtype A. The high incidence of Type A may be related to the severe symptom's characteristic of these infections, which increase the likelihood of patients visiting the emergency department and might be attributed to the multitude of factors like population density, population movement, aging population, vaccination, herd immunity, geographical region and seasonality effects [16].

The intensity of the influenza epidemic during the 2019 season in Abha generally followed past trends and peak influenza activity was generally similar to that in previous season in 2018. The increasing in influenza activity were detected in late November to mid- December and influenza activity peaked from the end of December to mid-March, which is relatively cold season in this region (Figure 2).

The seasonality of influenza epidemics was in line with the Northern Hemisphere for most countries in the region, with large primary peaks between January and March, and no or nearly undetectable secondary peaks. The most notable exceptions were Jordan (which showed a secondary peak in April) and the three countries located in the south-eastern part of the Arabian Peninsula, with Bahrain and Qatar having earlier primary peaks (in November and December) and a very clear secondary peak in March, while Oman having two peaks with very similar amplitudes in January and April. Whereas in Bahrain, Qatar and Oman, which were the southern- most countries roughly situated at the same latitudes as countries which are characterized by less defined influenza seasonality and multiple epidemic peaks, such as India [17] and southern China [18].

Climatic parameters, such as absolute humidity, temperature and rainfalls, shape influenza seasonality, both in temperate and tropical climate countries [19] and are likely to be the main driver of influenza seasonality in the Middle East and North Africa as well, although only a few studies have been conducted so far in this region. Population movements (e.g., annual Hajj pilgrimage, migrants and nomadic populations) might also contribute to determine influenza seasonality in some countries and the spread of epidemics across the region. Despite the observed differences between countries and the uncertainty about the main drivers of influenza epidemics, it is important to point out that all countries that we examined had either the primary or the secondary peak, or both, taking place between January and March. Therefore, it seems justified to align the recommendations for the timing of the annual vaccination campaigns for all countries in this region to the Northern Hemisphere

recommendations (i.e., late autumn), as is currently recommended by WHO [20].

In this study, the overall positivity rate of influenza viruses and its incidence by age group were similar to those reported by previous studies describing the epidemiology of respiratory viruses.[21]. Several studies have reported that men are more susceptible to viral infection and have more vigorous immune and behavioral responses [22]. However, there was no difference in the positivity rate or the incidence of ARI by sex in our study. The higher positivity rate of respiratory viruses in the pediatric group was compatible with that reported in other studies [23]. Additionally, a considerable number of reports about influenza infections among pediatric patients in Kingdom of Saudi Arabia was noted in the literature [24,25]. Each seasonal influenza epidemic presents an organizational challenge for healthcare systems. Timely information on the onset and the intensity of influenza epidemic is also important for the optimal deployment of human resources especially at regional level, as well as for the provision of sufficient quantities of medications [26,27]. Such a report with analysis can be a reminder to vaccinate members of society that are at risk of adverse influenza effects and increase accuracy of clinical diagnosis, as well as prompt taking samples for laboratory testing.

This report was based on data pertaining influenza season in 2019 from the department of infectious diseases of public health department in Abha City, which coincides with the period processed in the previously conducted yearly. As a limitation, the present study did not symbolize the true incidence as we have not taken mortalities due to influenza into consideration and involves the cases registered into the HESN system. Also, summary data on the proportions of influenza-positive cases with underlying medical conditions and how types and subtypes of circulating influenza viruses during the season matched with the seasonal flu vaccine are missed.

Conclusion

In conclusion, this study highlights the importance of conducting effective epidemiological surveillance for influenza virus in various regions in Abha specially in winter season with a peak in the month of February. Following each influenza season, additional analyses should be undertaken with a summary review of influenza activity during that season. These analyses can help inform the future timing of vaccination and identify high risk groups for targeted interventions.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

References

1. Flahault A. Global Monitoring of Influenza. Epidemiology. 2006;17(Suppl):S81.
2. Zafer, Najim, et al. "Acute respiratory tract infection symptoms and the uptake of dual influenza and pneumococcal vaccines among Hajj pilgrims." *International Maritime Health* 69.4 (2018): 278-284
3. Ramadan N, Shaib H. Middle East respiratory syndrome coronavirus (MERS-CoV): A review. *Germs*. 2019;9(1):35-42. Published 2019 Mar 1. doi:10.18683/germs.2019.1155
4. Alotaibi FY, Alhetheel AF, Alluhaymid YM, Alshibani MG, Almuhaydili AO, Alhuqayl TA, Alfayez FM, Almasabi AA. Influenza vaccine coverage, awareness, and beliefs regarding seasonal influenza vaccination among people aged 65 years and older in Central Saudi Arabia. Saudi Med J. 2019 Oct;40(10):1013-1018. doi: 10.15537/smj.2019.11.24587. Erratum in: Saudi Med J. 2020 Jan;41(1):105. PMID: 31588480; PMCID: PMC6887878

5. Alqahtani AS, Althobaity HM, Al Aboud D, Abdel-Moneim AS. Knowledge and attitudes of Saudi populations regarding seasonal influenza vaccination. Journal of infection and public health. 2017 Nov 1;10(6):897-900.

6. Sagor KH, AlAteeq MA. Beliefs, attitudes, and barriers associated with the uptake of the seasonal influenza vaccine among patients visiting primary healthcare clinics. *Saudi Med J.* 2018;39:690–696.

7. Mahfouz AA, Abdelmoneim I , Khan MY , Daffalla AA , Diab MM , ElGamal MN. Primary health care emergency services in Abha district of southwestern Saudi Arabia. Eastern Mediterranean Health Journal, 2007;13(1): 103-108

8. Shati AA, Ali AS, Al-Hakami AM, Asseri AA, Al-Qahatani SM. Pediatric viral respiratory infections in Saudi Arabia: Narrative and descriptive revisits for the etiology, epidemiology and clinical phenotypes with diagnostic challenges highlights. Kuwait Medical Journal. 2020 Jun 1;52(2):118-28.

9. Brookhart MA, Rothman KJ. Simple estimators of the intensity of seasonal occurrence. BMC medical research methodology. 2008 Dec;8(1):1-9.

10. Moghoofei M, Monavari SH, Mostafaei S, Hadifar S, Ghasemi A, Babaei F, Kavosi H, Tavakoli A, Javanmard D, Esghaei M, Khodabandehlou N. Prevalence of influenza A infection in the M iddle- E ast: A systematic review and meta- analysis. The clinical respiratory journal. 2018 May;12(5):1787-801.

11. Affifi RM, Omar SR, El Raggal AA A novel influenza A (H1N1) outbreak experience among residents of a long term-care facility in Saudi Arabia during 2010 seasonal flu circulation. Infect Dis Rep 2012; 4:e23

12. Altayep KM, Ahmed HG, Tallaa AT, Alzayed AS, Alshammari AJ, Ali Talla AT Epidemiology and clinical complication patterns of influenza A (H1N1 virus) in Northern Saudi Arabia. Infect Dis Rep 2017;9:6930

13. Balkhy HH, El-Saed A, Sallah M (2010) Epidemiology of H1N1 influenza among healthcare workers in a tertiary care center in Saudi Arabia: a 6-month surveillance study. Infect Control Hosp Epidemiol 2009 31:1004–1010

14. Agha A, Alrawi A, Munayco CV, Alayed MS, Al-Hakami M, Korairi H, Bella A Characteristics of patients hospitalized with 2009 H1N1 influenza in a tertiary care hospital in southern Saudi Arabia. Mediterr J Hematol Infect Dis 2012;4:e2012002

15. Al-Tawfiq JA, Abed M, Saadeh BM, Ghandour J, Shaltaf M, Babiker MM Pandemic influenza A (2009 H1N1) in hospitalized patients in a Saudi Arabian hospital: epidemiology and

clinical comparison with H1N1-negative patients. J Infect Public Health .2011;4:228–234

16. PRGIS Western. Epidemiological and virological characteristics of influenza in the Western Pacific Region of the World Health Organization, 2006–2010. *PloS One.* 2012; **7**: e37568.

17. Chadha MS, Potdar VA, Saha S, Koul PA, Broor S, Dar L, Chawla-Sarkar M, Biswas D, Gunasekaran P, Abraham AM, Shrikhande S. Dynamics of influenza seasonality at sub-regional levels in India and implications for vaccination timing. PloS one. 2015 May 4;10(5):e0124122.

18. Alshahrani NZ et al. FIFA World Cup 2022 in Qatar; Health Advice and Safety Issues for Travelling Attendees. Ann Med Health Sci Res. 2021;11:417-422.

19. Tamerius JD, Shaman J, Alonso WJ, Bloom-Feshbach K, Uejio CK, Comrie A, et al. Environmental predictors of seasonal influenza epidemics across temperate and tropical climates. PLoS Pathog. 2013;9(3):e1003194. pmid:23505366

20. World Health Organization. Monitoring system for vaccine-preventable diseases. http://apps.who.int/immunization_monitoring/globalsummary/schedules. Accessed on December 21, 2021.

21. Jeon JH, Han M, Chang HE, Park SS, Lee JW, Ahn YJ, Hong DJ. Incidence and seasonality of respiratory viruses causing acute respiratory infections in the Northern United Arab Emirates. Journal of medical virology. 2019 Aug;91(8):1378-84.

.

22. Avitsur R, Mays JW, Sheridan JF. Sex differences in the response to influenza virus infection: modulation by stress. Hormones and behavior. 2011 Feb 1;59(2):257-64

23. Calvo C, García-García ML, Blanco C, Vázquez MC, Frías ME, Pérez-Breña P, Casas I. Multiple simultaneous viral infections in infants with acute respiratory tract infections in Spain. Journal of Clinical Virology. 2008 Jul 1;42(3):268-72.

24. Al-Ayed MS, Asaad AM, Qureshi MA, Ameen MS. Viral etiology of respiratory infections in children in southwestern Saudi Arabia using multiplex reverse-transcriptase polymerase chain reaction. Saudi medical journal. 2014;35(11):1348.

25. Influenza Surveillance in Saudi Arabia [Internet]. Moh.gov.sa. 2020 [cited 9 April 2020]. Available from: https://www.moh.gov.sa/CCC/healthp/regulations/Documents/ISSA%20Protocol.pdf

26. Alshahrani NZ, Almohaishi HA, Alabadi M. Preventive measures to mitigate transmission of Covid-19 on aircrafts. Int J Med Rev Case Rep. 2021;5:93-95.

27. Andrew M, McElhaney J, McGeer A, Hatchette T, Leblanc J, Webster D et al. Influenza

surveillance case definitions miss a substantial proportion of older adults hospitalized with laboratory-confirmed influenza: A report from the Canadian Immunization Research Network (CIRN) Serious Outcomes Surveillance (SOS) Network. Infection Control & Hospital Epidemiology. 2020;:1-