



Key Findings

- Young children aged 0–4 years, and older adults, aged 65 years and older, had the highest ED visit rates due to influenza-like-illness (ILI) and pneumonia.
- Older adults, aged 65 years and older, had significant morbidity related to both ILI and pneumonia. This age group had the highest proportions of hospital admissions following emergency care for ILI (19%) and pneumonia (41%).
- Among urban and rural counties, noncore populations in Montana had the highest emergency department visit rates for both ILI and pneumonia.

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Acute Respiratory Infections, Pneumonia, and Emergency Care in Montana, 2010–2019

Introduction

Acute Respiratory Infections and Pneumonia

Respiratory diseases are some of the most common diseases worldwide, and include both acute and chronic conditions.¹ Among them, acute respiratory infections can be considered “the greatest single contributor to the overall burden of disease in the world” and result in over four million deaths each year.^{2,3} These acute respiratory infections refer to an assorted collection of diseases affecting the upper and lower respiratory tracts and differ from incurable respiratory conditions such as chronic obstructive pulmonary disease (COPD) and asthma.^{4,5}

Acute respiratory infections are often referred to as influenza-like-illnesses (ILI) in clinical and surveillance settings.^{6,7} However, influenza is not the cause of most of these illnesses; rather they result from other viral infections by rhinoviruses, respiratory syncytial virus, adenoviruses, and parainfluenza viruses. Bacteria (e.g., *Legionella spp.*, *Chlamydia pneumoniae*, *Mycoplasma pneumoniae*, and *Streptococcus pneumoniae*) may also cause acute respiratory infections; however, they are often less common agents of disease.⁸ Depending on the organism and severity of disease, acute respiratory infections may manifest with mild symptoms, such as: coughing, sneezing, sore throat, and/or runny nose. More severe cases may suffer from fever and night sweats, difficulty breathing, sputum production, chest pain, and/or rapid breathing.⁹ Severe illness may require emergency medical care or hospitalization.

Acute respiratory infections may result in the development of pneumonia, whereby the lungs fill up with fluid or pus. The severity of pneumonia is dependent on several factors, including: the cause of infection, age, and health status.¹⁰ Globally, pneumonia is the main cause of morbidity among older adults, while it is also the leading contributor to death for older adults and for children aged 0–4 years.^{11,12}

Surveillance

Given the burden of respiratory disease worldwide, surveillance programs for monitoring these infections have become some of the most robust within the public health infrastructure. These programs conduct population surveys, sentinel surveillance, and laboratory-based surveillance, often in combination with other strategies, in order to track cases with related clinical symptoms and confirmed disease.¹³



Hospital discharge data, primarily developed for billing purposes, is one information source available to these programs.

Purpose

This report examines emergency department (ED) discharge data related to ILI and pneumonia among Montana residents during 2010–2019 and offers recommendations to help prevent exposure to and further transmission of respiratory disease.

Methods

Using SAS Enterprise Guide, version 7.15 (SAS Institute, Inc.), ED visit records for 2010–2019 were selected from the Montana Hospital Discharge Data System (MHDDS).¹⁴

Records were included for analysis if (a) residence was listed as *Montana*, (b) age was not missing, (c) age was not over 105 years, and (d) sex was not missing or *unknown*. A total of 2,709,775 records were included for further analysis (Table 1). Records were grouped by urban and rural designations according to their county of residence’s level of urbanization: *Small Metro* (population less than 250,000), *Micropolitan* (population 10,000 to 49,999), and *Noncore* (population less than 10,000).¹⁵

For this analysis, ED visits related to ILI, influenza, and pneumonia were identified using International Classification of Diseases, 9th and 10th Revision, Clinical Modification diagnosis codes (ICD-9-CM and ICD-10-CM) following the case definitions of the Armed Forces Health Surveillance Center (AFHSC) (Table 2).^{6,16} These conditions were the only respiratory infections analyzed in this report. Records were classified by condition when a related diagnosis code of interest was found in the primary diagnosis field (first-listed) or any secondary diagnosis field (1–8).

Records were selected once for each associated category. For example, records with more than one pneumonia code were only counted once for the pneumonia category. If a record had codes for ILI,

Table 1: Montana ED Visits, by Category, Montana Residents, 2010–2019

Category	ED Visits, n (%)
Total	2,709,775 (100.0)
Sex	
Female	1,468,845 (54.2)
Male	1,240,930 (45.8)
Age Group (years)	
0 – 4	221,430 (8.2)
5 – 24	622,994 (23.0)
25 – 64	1,342,392 (49.5)
65 and Older	522,959 (19.3)
Urban and Rural Counties	
Small Metro	1,050,225 (38.8)
Micropolitan	693,009 (25.6)
Noncore	966,541 (35.7)
Discharge Year	
2010	268,460 (9.9)
2011	261,733 (9.7)
2012	252,039 (9.3)
2013	235,366 (8.7)
2014	258,350 (9.5)
2015	268,913 (9.9)
2016	280,545 (10.4)
2017	292,859 (10.8)
2018	293,211 (10.8)
2019	298,299 (11.0)

influenza, and pneumonia, the record was counted once in each of the three categories.

Odds ratios (OR) were calculated using logistic regression, with 95% confidence intervals (95%CI) based on profile likelihood and Chi-Square tests to measure significance. These OR were adjusted for sex, county of residence (e.g., Missoula County), and date of admission (i.e., month/day/year).

Limitations

ED visits in this report do not represent individual cases. The MHDDS does not contain individual identifiers and cannot be deduplicated.

On October 1, 2015, healthcare transactions for HIPAA covered entities transitioned from ICD-9-CM to ICD-10-CM code sets. Visits and admissions coded with ICD-9-CM may not be comparable to visits and admissions coded with ICD-10-CM.



Table 2: AFHSC Diagnosis Codes for Respiratory Infections

ICD-9-CM	ICD-10-CM
Influenza-Like-Illness (ILI)	
079.99, 382.9, 460, 461.9, 465.8, 465.9, 466.0, 486, 487.0, 487.1, 487.8, 488.01, 488.02, 488.09, 488.11, 488.12, 488.19, 488.81, 488.82, 488.89, 490, 780.6, 786.2	B97.89, H66.90, H66.91, H66.92, H66.93, J00, J01.90, J06.9, J09, J10, J11, J12.89, J12.9, J18.1, J18.8, J18.9, J20.9, J40, R05, R50.9
Influenza	
487.0, 487.1, 487.8, 488.01, 488.02, 488.09, 488.11, 488.12, 488.19, 488.81, 488.82, 488.89	J09, J10, J11
Pneumonia	
480, 481, 482, 483, 484, 485, 486, 487.0	A37.01, A37.11, A37.81, A37.91, A48.1, B25.0, J12, J13, J14, J15, J16, J17, J18

Race and ethnicity data, in the MHDDS, were only available for two years, 2018 and 2019; as a result, stratified analysis by these variables would have been severely limited. While racial disparities in healthcare access are widespread in the United States, and studies have shown differences in respiratory disease morbidity based on racial and ethnic characteristics, these variables were not explored in this surveillance report.^{19,20,21}

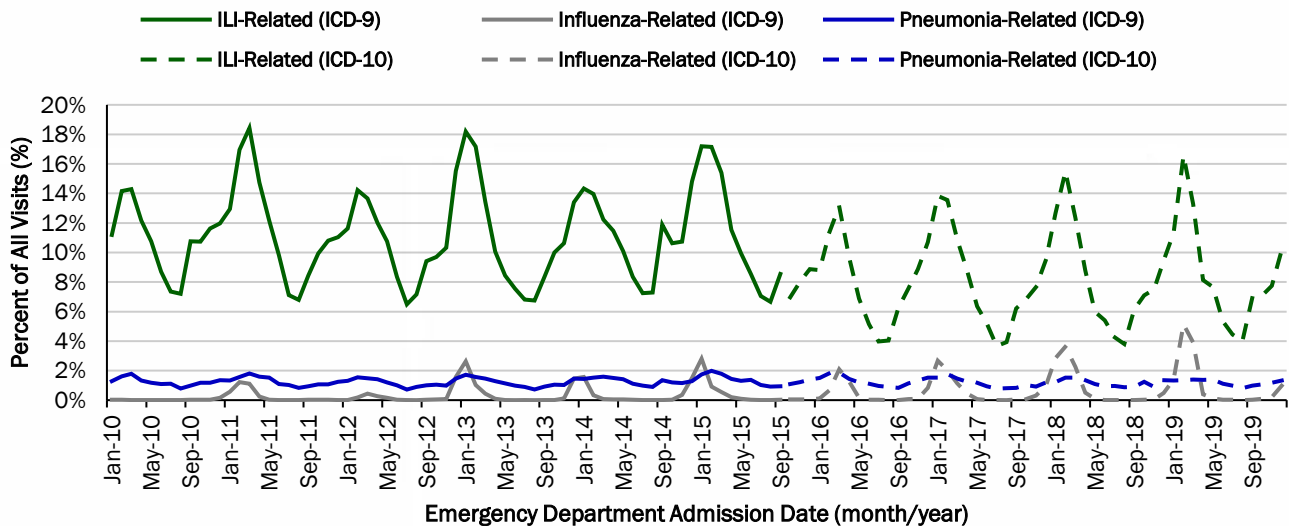
Disclaimer

While developed during the COVID-19 pandemic, this report did not explore the incidence or burden of COVID-19 in Montana, as 2020 hospital discharge data was not yet available for analysis.

Results

Analysis of Montana’s 2010–2019 ED data identified a total of 266,665 visits (9.8% of all visits) related to respiratory infections (i.e., ILI, influenza, or pneumonia). Among these visits, 53.4% were female and the median age was 22 years, range 0–105 years. Peak visit periods for all three conditions occurred primarily in the winter and spring months (i.e., December through May) (Figure 1). Among all respiratory infection-related visits, most discharges were documented as to home for self-care (94.8%), 4.2% were admitted to the hospital for further care, less than 0.1% listed death, and 0.3% left against medical advice.

Figure 1: Respiratory Infection-Related ED Visits, Percent of All Visits by Month and Year, Montana Residents, 2010–2019 (n = 2,709,775)





Influenza-Like-Illness

From 2010–2019, visits related to ILI represented 9.8% (264,489 visits) of all ED visits in Montana with an age-adjusted rate of 2,714.3 (95%CI: 2,703.7–2,724.8) visits per 100,000 population. 53.4% were female and the median age was 22 years, range 0 to 105 years.

The age-adjusted rate for ILI-related visits were higher among females, 2,939.9 (95%CI: 2,924.3–2,955.6) per 100,000 population, compared to males, 2,506.4 (95%CI: 2,492.2–2,520.6).

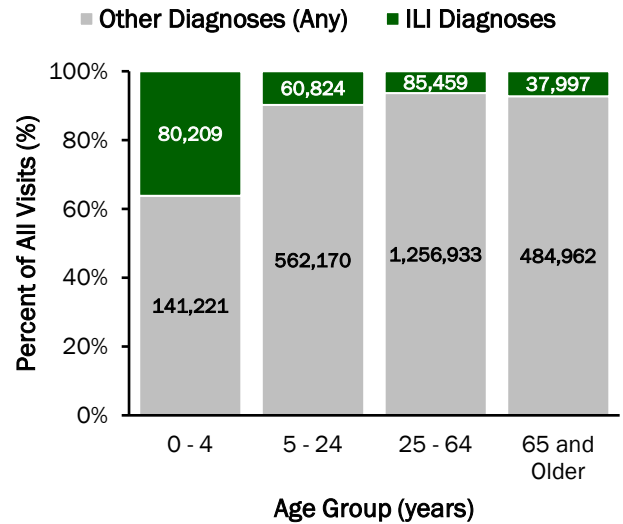
ILI-related visits among children aged 0–4 years occurred at rates over five-and-a-half times higher than other age groups (Table 3). While representing only 6.0% of Montana’s population, these children accounted for 30.3% of all ILI-related visits. Furthermore, among all ED visits by children aged 0–4 years, 36.2% were related to ILI (Figure 2).

Table 3: Influenza-Like-Illness-Related ED Visits and Age-Adjusted Visit Rate per 100,000 Population, Montana Residents, 2010–2019

Category	ILI Visits n (%)	Age-Adjusted Rate (95% Confidence Interval)
Total	264,489 (100.0)	2,714.3 (2,703.7 – 2,724.8)
Age Group (years)		
0 – 4	80,209 (30.3)	12,926.1 (12,836.8 – 13,015.9)
5 – 24	60,824 (23.0)	2,317.3 (2,299.0 – 2,335.8)
25 – 64	85,459 (32.3)	1,614.7 (1,603.9 – 1,625.5)
65 and Older	37,997 (14.4)	2,180.5 (2,158.6 – 2,202.5)
Urban and Rural Counties		
Small Metro	100,278 (37.9)	2,921.9 (2,903.6 – 2,940.3)
Micropolitan	60,791 (23.0)	2,091.2 (2,074.3 – 2,108.1)
Noncore	103,420 (39.1)	3,006.7 (2,987.8 – 3,025.7)

Children’s odds for visiting the ED with an ILI were more than seven times higher (OR: 7.1; 95%CI: 7.0–7.2; p<0.0001) than those aged 65 years and older. Compared to older adults (65 and older),

Figure 2: ED Visits with and without Influenza-Like-Illness Diagnoses, by Age Group, Montana Residents, 2010–2019 (n = 2,709,775)



those aged 5–24 years were 40% more likely to visit the ED with an ILI (OR: 1.4; 95%CI: 1.3–1.4; p< 0.0001), while those aged 25–64 years had a 10% reduced likelihood (OR: 0.9; 95%CI: 0.8–0.9; p<0.0001).

Among ED visits related to ILI, discharges to home for self-care was the most common (95.0%), followed by admission for further care (4.0%), left against medical advice (0.3%), and death (<0.1%). Of note, admission to the hospital for further care occurred most frequently among those aged 65 years and older (19.3%), while the percent admitted among other age groups were minimal in comparison (Table 4).

Table 4: Influenza-Like-Illness-Related ED Visits, Admissions to the Hospital for Further Care, by Age Group, Montana Residents, 2010–2019

Age Group (years)	ILI Visits n	Admitted to Hospital for Further Care, n (Stratum%)
Total	264,489	10,693 (4.0)
0 – 4	80,209	761 (0.9)
5 – 24	60,824	386 (0.6)
25 – 64	85,459	2,211 (2.6)
65 and Older	37,997	7,335 (19.3)



Pneumonia

From 2010–2019, there were 33,234 pneumonia-related ED visits. Ninety-four percent of these visits also included additional diagnosis codes for ILI. Pneumonia-related visits occurred at an age-adjusted rate of 301.8 (95%CI: 298.5–305.2) visits per 100,000 population. Among pneumonia-related visits, 48.1% were female and the median age was 56 years, range 0 to 105 years.

The age-adjusted rate for pneumonia-related visits was higher among males than females, 319.4 (95%CI: 314.5–324.3) and 288.5 (95%CI: 283.9–293.1) per 100,000 population, respectively.

Those aged 25 years and older accounted for 75.7% of all pneumonia-related visits (Table 5). However, the age-specific rate of pneumonia was highest among adults aged 65 years and older, followed closely by children aged 0–4 years. Odds for visiting the ED with pneumonia were lowest among children and young adults aged 5–24 years (OR: 0.2; 95%CI: 0.2–0.2); $p < 0.0001$) and adults aged 25–64 years (OR: 0.4; 95%CI: 0.3–0.4); $p < 0.0001$), when compared to older adults aged 65 years and older. Children, aged 0–4 years, also demonstrated reduced odds compared to those aged 65 years and older, but were only 20% less likely to have visited the ED with pneumonia (OR: 0.8; 95%CI: 0.8–0.8; $p < 0.0001$).

Table 5: Pneumonia-Related ED Visits and Age-Adjusted Visit Rate per 100,000 Population, Montana Residents, 2010–2019

Category	Pneumonia Visits n (%)	Age-Adjusted Rate (95% Confidence Interval)
Total	33,234 (100.0)	301.8 (298.5 - 305.2)
Age Group (years)		
0 - 4	4,559 (13.7)	734.7 (713.5 - 756.3)
5 - 24	3,507 (10.6)	133.6 (129.2 - 138.1)
25 - 64	12,035 (36.2)	227.4 (223.3 - 231.5)
65 and Older	13,133 (39.5)	753.6 (740.8 - 766.6)
Urban and Rural Counties		
Small Metro	9,774 (29.4)	267.0 (261.6 - 272.4)
Micropolitan	6,588 (19.8)	207.4 (202.2 - 212.5)
Noncore	16,872 (50.8)	401.8 (395.3 - 408.2)

Among urban and rural county classifications, noncore areas had the highest rates of pneumonia-related ED visits. (Table 5).

Generally, most pneumonia-related ED visits ended in a discharge home for self-care (75.4%); another 21.9% were admitted to the hospital for further care, 0.3% died in the ED, while 0.5% left against medical advice. Looking within each age group, those aged 65 years and older recorded the highest percent of admissions to the hospital after visiting the ED with pneumonia (Table 6).

Table 6: Pneumonia-Related ED Visits, Admissions to the Hospital for Further Care, by Age Group, Montana Residents, 2010–2019

Age Group (years)	Pneumonia Visits, n	Admitted to Hospital for Further Care, n (Stratum%)
Total	33,234	7,284 (21.9)
0 - 4	4,559	412 (9.0)
5 - 24	3,507	173 (4.9)
25 - 64	12,035	1,354 (11.3)
65 and Older	13,133	5,345 (40.7)

Conclusion

From 2010–2019, roughly one out of every ten ED visits in Montana involved an ILI, while pneumonia accounted for a little over 1% of all visits. Young children, aged 0–4 years, were the most heavily impacted age group for both diagnoses, recording disproportionately high ED visit rates related to ILI and the second highest rates for pneumonia-related visits. Older adults, aged 65 years and older, also showed significant morbidity related to both ILI and pneumonia, with the highest proportions of hospital admissions following emergency care and the highest rate of pneumonia-related ED visits.

ILI and pneumonia can pose key health concerns for all individuals, particularly among young children and older adults in Montana. This concern is heightened for those who smoke or have underlying medical conditions, factors which increase the likelihood of contracting respiratory disease and experiencing severe outcomes.^{22, 23}



Further analysis of these conditions, using the MHDDS, should explore the causative agents of these diagnoses (i.e., specific viruses and bacteria involved) and geographic incidence, as well as racial and ethnic burdens when the data becomes available. Understanding these features, in addition to risk factors such as vaccination status, will help to identify how and where public health interventions and education will be most impactful.

Recommendations ^{24, 25 26}

Vaccination

Ensure up-to-date vaccinations for infants, children, adolescents, and adults following the Advisory Committee on Immunization Practices' (ACIP) recommendations and guidelines.

Avoid Contact with Sick Persons

Reduce contact with sick persons to minimize disease transmission opportunities. Stay home and away from others when sick to avoid spreading disease.

Cover Your Mouth and Nose

Contain coughs and sneezes with a barrier (e.g., tissue, sleeve, face mask, or hand) to limit the aerosolization of infectious droplets.

Clean Your Hands

Practice good hand hygiene to reduce the spread of germs. Wash hands regularly with warm water and soap, when possible, or else clean them with an alcohol-based hand rub.

Avoid Touching Your Eyes, Nose, and Mouth

Your eyes, nose, and mouth are channels for germs to enter your body. Avoid touching these areas to reduce the likelihood of contracting disease from germs on your hands.

Clean and Disinfect

Contact with contaminated surfaces is a common way of contracting disease. Cleaning frequently used surfaces and items at work, school, and home, especially when people are or have been ill, will reduce the probability of disease transmission from contaminated surfaces.

References

1. Practical Approach to Lung Health: Manual on Initiating PAL Implementation. Geneva: World Health Organization; 2008. 2, Estimating the burden of respiratory diseases. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK310631/>
2. Thomas Ferkol and Dean Schraufnagel. The Global Burden of Respiratory Disease. *Annals of the American Thoracic Society*, Vol. 11, No. 3, pp 404–406, Mar 2014.
3. Mayor, Susan. Acute respiratory infections are world's third leading cause of death. *BMJ* 2010; 341: c6360.
4. Simoes EAF, Cherian T, Chow J, et al. Acute Respiratory Infections in Children. In: Jamison DT, Breman JG, Measham AR, et al., editors. *Disease Control Priorities in Developing Countries*. 2nd edition. Washington (DC): The International Bank for Reconstruction and Development / The World Bank; 2006. Chapter 25. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK11786/> Co-published by Oxford University Press, New York.
5. World Health Organization. 2020. Chronic respiratory diseases. https://www.who.int/health-topics/chronic-respiratory-diseases#tab=tab_1.
6. Armed Forces Health Surveillance Branch. 2015. "Influenza-Like Illness (ILI)." *Military Health System (Health.mil)*. October. <https://health.mil/Military-Health-Topics/Combat-Support/Armed-Forces-Health-Surveillance-Branch/Epidemiology-and-Analysis/Surveillance-Case-Definitions>.
7. European Centre for Disease Prevention and Control (ECDC). "Facts about Influenza Surveillance: Sentinel Surveillance." <https://www.ecdc.europa.eu/en/seasonal-influenza/surveillance-and-disease-data/facts-sentinel-surveillance>
8. Centers for Disease Control and Prevention (CDC). Considerations for distinguishing influenza-like illness from inhalational anthrax. *MMWR Morb Mortal Wkly Rep*. 2001; 50(44): 984-986.
9. Heymann, David L. 2015. *Control of Communicable Diseases Manual*. 20th Edition. Washington, DC: American Public Health Organization.
10. National Institutes of Health, National Heart, Lung, and Blood Institute. 2020. "Health Topics: Pneumonia". <https://www.nhlbi.nih.gov/health-topics/pneumonia>.
11. American Thoracic Society. 2020 "Infections and Problems from Bacteria, Viruses, Molds and Fungi: Top 20 Pneumonia Facts 2019". <https://www.thoracic.org/patients/patient-resources/resources/top-pneumonia-facts.pdf>



12. Chebib, N., Cuvelier, C., Malézieux-Picard, A. et al. Pneumonia prevention in the elderly patients: the other sides. *Aging Clin Exp Res* (2019). <https://doi.org/10.1007/s40520-019-01437-7>
13. Nsubuga P, White ME, Thacker SB, et al. Public Health Surveillance: A Tool for Targeting and Monitoring Interventions. In: Jamison DT, Breman JG, Measham AR, et al., editors. *Disease Control Priorities in Developing Countries*. 2nd edition. Washington (DC): The International Bank for Reconstruction and Development / The World Bank; 2006. Chapter 53. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK11770/> Co-published by Oxford University Press, New York.
14. Montana Hospital Discharge Data System, 2010-2018. Office of Epidemiology and Scientific Support, Public Health and Safety Division. Montana Department of Public Health and Human Services. Data provided courtesy of participating MHA members.
15. Ingram DD, Franco SJ. 2013 NCHS urban-rural classification scheme for counties. *National Center for Health Statistics. Vital Health Stat* 2(166). 2014.
16. Armed Forces Health Surveillance Branch. 2015. Pneumonia and Influenza (P&I). Military Health System (Health.mil). <https://health.mil/Military-Health-Topics/Combat-Support/Armed-Forces-Health-Surveillance-Branch/Epidemiology-and-Analysis/Surveillance-Case-Definitions>.
17. Klein RJ, Schoenborn CA. Age adjustment using the 2000 projected U.S. population. *Healthy People Statistical Notes*, no. 20. Hyattsville, Maryland: National Center for Health Statistics. January 2001.
18. National Center for Health Statistics. Vintage 2018 postcensal estimates of the resident population of the United States (April 1, 2010, July 1, 2010-July 1, 2018), by year, county, single-year of age (0, 1, 2, ..., 85 years and over), bridged race, Hispanic origin, and sex. Prepared under a collaborative arrangement with the U.S. Census Bureau. Available from: http://www.cdc.gov/nchs/nvss/bridged_race.htm as of June 25, 2019, following release by the U.S. Census Bureau of the unbridged Vintage 2018 postcensal estimates by 5-year age group on June 20, 2019.
19. National Academies of Sciences, Engineering, and Medicine; Health and Medicine Division; Board on Health Care Services; Committee on Health Care Utilization and Adults with Disabilities. *Health-Care Utilization as a Proxy in Disability Determination*. Washington (DC): National Academies Press (US); 2018 Mar 1. 2, Factors That Affect Health-Care Utilization. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK500097/>
20. Deborah L. Dee, et al. Racial and Ethnic Disparities in Hospitalizations and Deaths Associated with 2009 Pandemic Influenza A (H1N1) Virus Infections in the United States. *Annals of Epidemiology*, Volume 21, Issue 8. 2011. Pages 623-630. ISSN 1047-2797. <https://doi.org/10.1016/j.annepidem.2011.03.002>.
21. Barbara Allen, Centers for Disease Control and Prevention. H1N1 Vaccination: Reaching the Hard to Reach. *Dialogue4Health*. November 30, 2009. <https://www.dialogue4health.org/resource-library/detail/barbara-allen-ili-syndromic-surveillance>
22. National Center for Immunization and Respiratory Diseases (NCIRD), Centers for Disease Control and Prevention. (2019) Pneumonia: Lower Your Risk of Pneumonia. <https://www.cdc.gov/pneumonia/index.html>
23. National Center for Immunization and Respiratory Diseases (NCIRD), Centers for Disease Control and Prevention. (2019) Influenza (Flu): People at High Risk for Flu Complications. <https://www.cdc.gov/flu/highrisk/index.htm>
24. National Center for Immunization and Respiratory Diseases (NCIRD), Centers for Disease Control and Prevention. (2019) Seasonal Influenza (Flu): Healthy Habits to Help Prevent Flu. <https://www.cdc.gov/flu/prevent/actions-prevent-flu.htm>
25. National Center for Immunization and Respiratory Diseases (NCIRD), Centers for Disease Control and Prevention. (2020) Coronavirus Disease 2019 (COVID-19): How to Protect Yourself & Others. <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/prevention.html>
26. National Center for Immunization and Respiratory Diseases, Division of Bacterial Diseases, Centers for Disease Control and Prevention. (2019) Pneumococcal Disease: Prevention. <https://www.cdc.gov/pneumococcal/about/prevention.html>