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Intrinsic and Extrinsic Factors Related to the Incident of Toddler Pneumonia

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Article Info	Abstract
	According to the Regional Task Unit of Banda Raya Public Health Service, Banda Aceh City, there was an increase in Pneumonia Toddlers from 62 patients in 2017 to 135 patients in 2018. This study aims to determine the intrinsic and extrinsic risk factors related to the incidence of toddlers pneumonia in the work area of the Regional Task Unit of Banda Raya Public Health Service, Banda Aceh City, in 2019. Spatial analysis was used to analyze and describe the results of toddler pneumonia distribution and to see the relationship between intrinsic and extrinsic factors to the incidence of toddlers pneumonia using a Case-Control Study or Retrospective Study design. This study uses a total population sample of 142 people, consisting of 71 cases and 71 controls using a 1:1 ratio. The results showed that the variables associated with pneumonia were education (OR=2.47; 95% CI=1.51-5.32; p value=0.049), vitamin A administration (OR=4.56; 95% CI=1.81-11.49; p value=0.001), and exclusive breastfeeding (OR=0.35; 95% CI=0.11-1.09; p value=0.072). Intrinsic factors related to the incidence of pneumonia are vitamin A administration and exclusive breastfeeding. Then the Extrinsic factor related is education. The recommendation is to improve MCH management, such as complete basic immunization, vitamin A administration, and others.

Introduction

Pneumonia is the most killer of toddlers worldwide, more than AIDS, malaria, and measles. Based on the World Health Organization (WHO) estimation, more than 2 million toddlers in the world die from pneumonia (1 toddler/20 seconds) out of 9 million total under-five deaths. Every year more than 95% of new pneumonia cases occur in developing countries, and more than 50% of pneumonia cases occur in Southeast Asia and Sub-Saharan Africa. In 2008 there were 8.8 million child deaths in the world. Of which 1.6 million deaths were caused by pneumonia. Pneumonia cases in Indonesia reached 6 million people. So that Indonesia was ranked 6th in the world for pneumonia cases (WHO, 2008).

Based on the Indonesian Health Profile,

pneumonia is the cause of 15% of under-five deaths, which is estimated at 922,000 toddlers in 2015. In Indonesia, under-five mortality due to Pneumonia in 2017 was 0.34%. It is higher than in 2015, which was 0.22%. In the infant, the mortality rate was slightly higher at 0.56% than the 1-4 year age group, namely 0.23% (Dinkes Banda Aceh, 2016). The pneumonia incidence and prevalence in Indonesia are 1.8% and 4.5%. The five highest case provinces, namely East Nusa Tenggara, Papua, Central Sulawesi, West Sulawesi, and South Sulawesi. The 2013 Basic Health Research Report (Riskesdas) also shows that pneumonia is the most cause of infant mortality (0-11 months) by 23.80% and as the second cause of under-five mortality (1–4 years), which is 15.50%. It ranks second after diarrhea out of the top 10 death. On average, every 83 toddlers die every day due to pneumonia. It shows that it is a disease

that is among the most public health problem contributing to the high infant mortality rate in Indonesia (Dinkes Banda Aceh, 2016).

In Aceh Province, Pneumonia is the second rank of all under-five deaths. The estimated number of pneumonia sufferers is 10 percent of the toddlers in the same area and period. Pneumonia in toddlers in Banda Aceh City in 2016 was estimated to be 2,378 sufferers, with a gender distribution of 1,224 boys and 1,154 girls. Meanwhile, in 2017 there were 2,157 patients, with a distribution of 574 children aged less than one year and 1,583 children aged 1-4 years (Dinkes Banda Aceh, 2016).

According to the latest report, the number of toddlers with pneumonia increased from the previous year, which was 212 sufferers. Most of them were found in the Regional Task Unit of Banda Raya Public Health Service, with the details of 135 cases. Then 23 cases in Jaya Baru, 15 cases in Kuta Alam, 9 cases in Jeulingke, 7 cases in Ulee Kareung, 6 cases in Kopelma Darussalam, 6 cases in Baiturrahman, and 1 case in Meuraxa (Dinkes Banda Aceh, 2016).

Based on the Regional Task Unit of Banda Raya Public Health Service in Banda Aceh City, there is an increase in cases of Pneumonia Toddlers from 62 patients in 2017 to 135 in 2018. This study aims to analyze the intrinsic risk factors, namely Nutritional Status, History of LBW, Exclusive Breastfeeding, Vitamin A administration, Basic Immunization Completeness, and Complementary Breastfeeding. And extrinsic risk factors, namely Mother's Education, Family Income, Smoking Habits at Home, Types of Walls, and Types of Floors. Those factors are associated with the incidence of Pneumonia in toddlers. This study also uses spatial analysis to see the point coordinator of pneumonia cases in toddlers at the Regional Task Unit of Banda Raya Public Health Service, Banda Aceh City, in 2019.

Method

This study used a Case-Control Study design. The dependent variable is the incidence of pneumonia in toddlers. The Independent Variables were Toddler Age, Gender, Nutritional Status, History of LBW, Exclusive Breastfeeding, Vitamin A, Basic Immunization Completeness, Weaning Food, Mother's Education, Mother's Knowledge, Family Income, Home Ventilation, Smoking Habit in the House, Wall Type, Floor Type, House Occupancy Density, and Residential Density. This study also uses spatial analysis to see the coordinates of pneumonia cases in toddlers. The research took place in the working area of the Banda Raya Public Health Service. The selection of the object and location is due to it has many cases of pneumonia in toddlers. The population in this study were all toddlers aged 12–59 months who were diagnosed with pneumonia at the Regional Task Unit of Banda Raya Public Health Service, Banda Aceh City, based on the MCH registration from January to June 2019. The sampling technique in this study was total sampling. So the sample in this study consisted of 71 cases and 71 controls. The control uses a simple random sampling technique, taken from toddlers who have a house close to those with pneumonia.

Result and Discussion

Table 1. Respondent Characteristic

Variable	Mean	Standard Deviation	Min	Max
Mother Age	32.16 (tahun)	5.89	22	50
Family Income	2.313.169 (Juta)	1.666.300	0	12.000.000
Birth Weight	3.034 (Gram)	703.37	1.500	8.800
BW/A	-1.07	0.64	-2.9	0.89
Body Weight	11.65 (Kg)	2.34	8	18
Body Height	86.44 (Cm)	10.71	68	112

Source: Primary Data, 2019

Based on the numerical data above, it shows that the average age of the mother is 32 years or more, the average family income is 2,313,169 million. Then the average birth weight is 3,034 grams, the average weight based on age is -1.07 SD, the average weight for toddlers is 11.65 kg, the average height for toddlers is 86.44 cm.

Table 2. Relationship of Instrinsic dan Extrinsic Factor Related to Pneumonia Incident in Toddlers

Independent Variables	Pneumonia						OR	CI95%	P value
	Control		Case		Total				
	n	%	n	%	n	%			
Education									
High	19	26.76	19	26.76	38	26.76			
Middle	49	69.01	43	60.56	92	64.79	0.87	0.41-1.86	0.735
Low	3	4.23	9	12.68	12	8.45	3	0.70-12.82	
Occupation									
Civil Servant/Military/Police	5	7.04	5	7.04	10	7.04			
Private Sector/Entrepreneur	6	8.45	5	7.04	11	7.75	0.83	0.14-4.63	0.83
Housewife	60	84.51	61	85.92	121	85.21	1.07	0.27-3.69	0.98
Family Income									
High	24	33.80	17	23.94	41	28.87			
Low	47	66.20	54	76.06	101	71.13	1.62	0.77-3.37	0.197
Toddler Nutritional Status									
Well-Nourished	71	100	68	95.77	139	97.89			
Malnourished	0	0	3	4.23	3	2.11	1	(Omitted)	-
Low Birth Weight (LBW)									
No	65	91.55	60	84.51	125	88.03			
Yes	6	8.45	11	15.49	17	11.97			
Exclusive Breast Feeding									
Yes	33	46.48	18	25.35	51	35.92			
No	38	53.52	53	74.65	91	64.08	0.43	0.17-1.09	0.078
Vit A Administration									
Complete	33	46.48	18	25.35	51	35.92			
Incomplete	38	53.52	53	74.65	91	64.08	2.55	1.25-5.19	0.010
Basic Immunization									
Complete	14	19.72	11	15.49	25	17.61			
Incomplete	57	80.28	60	84.51	117	82.39	1.33	0.56-3.19	0.509
Weaning Food									
No	23	32.39	27	38.03	50	35.21			
Yes	48	67.61	44	61.97	92	64.79	0.78	0.39-1.55	0.483
Smoking Habit in the House									
No	42	59.15	31	43.66	73	51.41			
Yes	29	40.85	40	56.34	69	48.59	1.86	0.95-3.63	0.066
House Wall									
Sufficient	58	81.69	55	77.46	113	79.58			
Insufficient	13	18.31	16	22.54	29	20.42	1.29	0.57-2.94	0.533
House Floor									
Water Proof	70	98.59	69	97.18	139	97.89			
Not Water Proof	1	1.41	2	2.82	3	2.11	2.02	0.17-22.89	0.567
Total	71	100	71	100	142	100			

Source: Primary Data, 2019

The proportion of respondents who gave exclusive breastfeeding and suffered from pneumonia was 25.35% lower than respondents who gave exclusive breastfeeding who did not suffer from pneumonia of 46.48%, while the proportion of respondents who did not give exclusive breastfeeding and suffered from pneumonia was 74.65% higher than respondents who did not give exclusive breastfeeding and did not suffer from pneumonia by 53.52%. The statistical tests found that respondents who did not give exclusive breastfeeding had a risk of preventing pneumonia by 43% compared to respondents who gave exclusive breastfeeding with a p-value of 0.078, which means that there is no significant relationship between exclusive breastfeeding and the incidence of pneumonia.

The proportion of respondents who gave complete vitamin A and suffered from pneumonia was 25.35% lower than that of complete vitamin A and did not suffer from pneumonia by 46.48% while the proportion of respondents who gave incomplete vitamin A and suffered from pneumonia was 74.65% higher than the respondents who had

incomplete administration of vitamin A and not suffering from pneumonia by 53.52%. The statistical tests showed that respondents who did not provide complete vitamin A had a 2.55 times risk of suffering from pneumonia compared to respondents who gave complete vitamin A with a p-value of 0.010, which means that there is a significant relationship between the administration of vitamin A and the incidence of pneumonia.

The proportion of respondents who do not smoke at home and suffer from pneumonia is 43.66% lower than respondents who do not smoke at home and do not suffer from pneumonia by 59.15%, while respondents who smoke in their homes and suffer from pneumonia is 56.34% higher than respondents who smoke in their home and do not suffer from pneumonia by 40.85%. The results of statistical tests showed that respondents who smoked at home had a 1.86 times risk of suffering from pneumonia compared to respondents who did not smoke at home with a p-value of 0.066, which means that there is no significant relationship between smoking habits in the

Table 3 Initial Model of Instrinsic dan Extrinsic Risk Factor Related to Pneumonia Incident in Toddlers

Pneumonia	OR	CI 95 %	P value
Middle Education	1.12	0.34-3.712	0.844
Low Mother Education	10.08	1.62-80.11	0.029
Private sectors/Enterpreneur	1.52	0.16-14.33	0.712
Housewife	1.36	0.19-9.50	0.756
Low Income	1.26	0.43-3.68	0.672
Malnourishment	1	-	-
LBW	1.18	0.314-4.458	0.803
Without Exclusive Breast Feeding	0.37	0.109-1.298	0.122
Incomplete Vitamin A Administration	6.60	2.159-20.225	0.001
Incomplete Basic Immunization	1.09	0.340-3.534	0.878
With Weaning Food	0.81	0.339-1.980	0.658
Smoking Habit In The House	1.49	0.601-3.711	0.386
Insufficient House Wall	1.36	0.403-4.654	0.614
House Floor is not Water Proof	4.00	0.133-119.889	0.424

Source: Primary Data, 2019

The table above shows that not all intrinsic and extrinsic risk factors affect the incidence of pneumonia. The low respondent education risk 10.08 times having pneumonia with an OR = 10.08 and a p-value of 0.029. The

most influential risk factor for the incidence of pneumonia was the incomplete administration of vitamin A with OR = 6.60. It means they had a risk of 6.60 times suffering from pneumonia with a p-value = 0.001.

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Table 4. Final Model of Instrinsic dan Extrinsic Risk Factor Related to Pneumonia Incident in Toddlers

Pneumonia	OR	CI 95 %	P-value
Incomplete Vitamin A Administration	4.56	1.81-11.49	0.001
Low Mother Education	2.47	1.15-5.32	0.049
Without Exclusive Breast Feeding	0.35	0.11-1.09	0.072

Source: Primary Data, 2019

The results of the multivariate analysis showed that the most influential factor was the incomplete administration of vitamin A with OR=4.56, which means it has a 4.56 times greater risk of suffering from pneumonia. From the table above, there are also factors related to the incidence of pneumonia, namely low mother education with a p-value of 0.049 and incomplete exclusive breastfeeding with a p-value of 0.072.

Table 5. Instrinsic dan Extrinsic Risk Factor Related to Pneumonia Incident in Toddlers by Group

Group	OR Unadjusted SES	OR Adjusted SES
Host		
Nutritional Status	1	1
LBW History	1.18	1.52
Incomplete Breast Feeding	0.37	0.32
Incomplete Vitamin A Adminstration	6.60	3.85
Incomplete Basic Immunization	1.09	0.74
With Weaning Food	0.81	0.81
Physical Environment		
Smoking Habit in the House	1.49	1.57
Insufficient House Wall	1.36	1.07
House Floor is not Water Proof	4.00	1.89
Social Economic Factors (SEF)		
Middle Mother Education 1.12		
Low Mother Education 10.08		
Low Family Income 1.26		

Source: Primary Data, 2019

Above tables shows there is no significant difference of OR Unadjusted after the Social Economic Factors (SEF) variables is excluded to become SEF OR Adjusted.

Image 1. Distribution Map of Pneumonia Toddlers in Work Area of Regional Task Unit of Banda Raya Public Health Service, Banda Aceh City, 2019

The map indicates that the toddlers pneumonia incident in Banda Raya District was most found in Peunyerat Village, namely 19 cases and the least is in Lhong Cut Village with only one case.
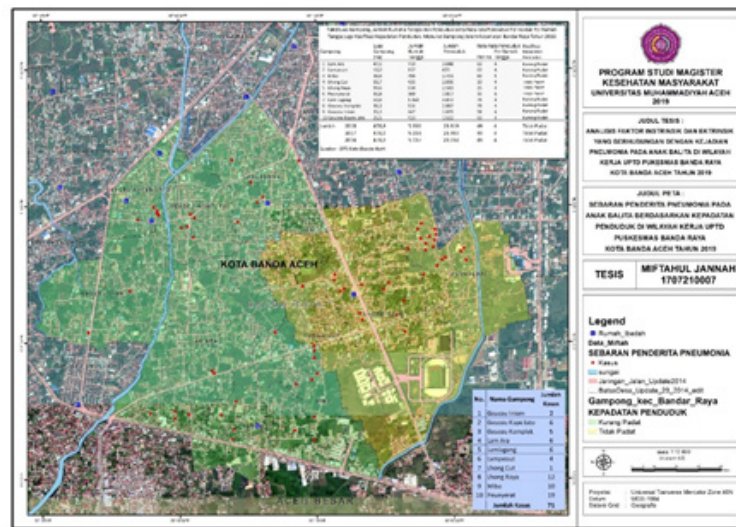

Image 2. Distribution Map of Pneumonia Toddlers by Population Density in Work Area of Regional Task Unit of Banda Raya Public Health Service, Banda Aceh City, 2019

Based on the map above, 71 pneumonia toddlers spread over ten villages in Banda Raya District. Pneumonia sufferers at most are 19 patients, and the least is one patient, both in non-populated areas. However, from the population density point of view, most pneumonia toddlers cases are in Peunyeurat village. As many as 19 pneumonia toddlers. While on the vacant area, there are no cases. In areas that are not densely populated, we found only one pneumonia toddler in Lhong cut village. In this study, exclusive breastfeeding became the independent variable. The exclusive breastfeeding category is 83.10% higher than not giving exclusive breastfeeding by 16.90%. The statistical tests found that respondents who did not give exclusive breastfeeding had a risk of preventing pneumonia by 43% compared to those who gave exclusive breastfeeding with a p-value of 0.078. It means that there is no significant relationship between exclusive breastfeeding and the incidence of pneumonia.

The multivariate analysis explained that after being combined with other risk variables, the without exclusive breastfeeding variable has an OR value of 0.37, meaning that respondents who do not give exclusively breastfeeding are at risk of experiencing pneumonia by 37% compared to those who do exclusive breastfeeding. Then after stepwise (0.25), the exclusive breastfeeding variable entered the final model because it had a p-value of 0.072. It means that there was no relationship between exclusive breastfeeding and pneumonia with OR value = 0.35. It means respondents without exclusively breastfeeding had a 35% risk of experiencing pneumonia than those with exclusive breastfeeding.

This study is not in line with the research of Prina & Torres (2015), using a Case-Control design. They proved a significant relationship between an exclusive breastfeeding history and the incidence of pneumonia (OR = 8,953, 95% CI: 2,843–28,232). It means that toddlers who are exclusively breastfed for less than six months are 8.953 times more likely to suffer from pneumonia than those who are exclusively breastfed for more than or equal to 6 months. The researcher assumes that exclusive breastfeeding can also prevent pneumonia because it is the main food source for infants aged 0-6 months. Breast milk contains many nutrients that support the toddler's growth without the need to provide other additional foods (Wei & Cui, 2020; Jain et al, 2020; Mani, 2018).

In this study, vitamin A became the independent variable. The complete vitamin

A administration category is lower by 35.92%. While the incomplete was 64.08%. The results of statistical tests showed that respondents who do not follow complete vitamin A administration had a 2.55 times risk of suffering from pneumonia than those who follow complete vitamin A administration with a p-value of 0.010, which means that there is a significant relationship between the administration of vitamin A and the incidence of pneumonia (Giuliano & Quinn, 2018; Grief & Loza, 2018).

The multivariate analysis explained that after being combined with other risk variables, the without vitamin A administration variable has an OR value of 6.6, meaning that toddlers without vitamin A administration had a risk of experiencing pneumonia by 6.6 times than those with vitamin A administration. Then after stepwise (0.25), we include the vitamin A administration variable in the final model because it had a p-value of 0.001. It means there is a relationship between the vitamin A administration variable and Pneumonia, and obtained an OR value = 4.56. It means, the toddlers with incomplete vitamin A administration has a risk of Pneumonia 4.56 times higher than those with complete vitamin A administration category.

This study is in line with Adawiyah & Duarsa (2012), finding the toddlers' proportion without Vit A administration in the case group was 38.5%, while the control group was 18.5%. From the bivariate analysis, the p-value = 0.020 (p < 0.05), indicating a statistically significant effect between the administration of Vitamin A to toddlers and the incidence of pneumonia in toddlers at the Susunan Baru Public Health Service in Bandar Lampung City. Researchers assume that the administration of vitamin A has a relationship with the incidence of pneumonia. If vitamin A is not given it will be at risk of developing pneumonia. Vitamin A is useful for increasing immunity and protecting the respiratory tract from bacterial infections. If there is a lack of vitamin A, the body can experience respiratory problems. It is supported by research by Mandell & Niederman (2019), which states that Vitamin A functions to stabilize the structure and function of the mucosal surface and is also involved in the immune response (especially T-cell function)

and mucus production. In infants with mild vitamin A deficiency, there is a twofold increase in the incidence of respiratory tract disease and a 4-12 times increase in childhood mortality (Stephen et al., 2019; Ramirez et al., 2017).

In this study, smoking habits in the house became the independent variable. The category of not smoking in the house is 51.41%, approaching the percentage of smoking in the house, 48.59%. The statistical tests showed that respondents who smoke in the house had a 1.86 times risk of toddler pneumonia than those who don't, with a p-value of 0.066. It means that there is no significant relationship between smoking habits in the house and the incidence of pneumonia. The multivariate analysis explained that after being combined with other risk variables, the smoking habit in the house variable had an OR value of 1.49. It means that smoking habit in the house has a risk of experiencing pneumonia by 1.49 times than those who do not. After stepwise (0.25), we do not include it in the final model because it has a p-value > 0.25, meaning no relationship between the smoking habit at home variable and Pneumonia.

This study is not in line with the research of Fatichaturrachma, Suhartono, and Dharminto (2016). It obtained a p-value of 0.039 which means there is a relationship between smoking in the house and the incidence of pneumonia in toddlers. Then the value of OR = 2.949. It indicates that toddlers who live with a smoker in the house have a 2.9 times greater risk of developing pneumonia than those who live at home without smokers in the house (Gattinoni et al., 2020; DiBardino & Wunderink, 2015). The researcher assumes that the presence of smokers in the house is a risk factor for pneumonia in toddlers. If toddlers have weak antibodies, they will be at risk for diseases including pneumonia (Chou et al., 2019; Restrepo & Reyes, 2018). Based on the study, most toddlers were exposed to cigarette smoke in both cases and controls. Cigarette smoke contains harmful substances that can interfere with the human respiratory system, and cigarette smoke is one of the risk factors for pneumonia in toddlers (Koo et al., 2018; Zhu et al., 2019).

Conclusion

Based on the results of research and discussion on the Analysis of Intrinsic and Extrinsic Factors related to the Incidence of Pneumonia in Toddlers in the Regional Task Unit Work Area of the Banda Raya Public Health Service Banda Aceh City in 2019, after multivariate analysis (stepwise <25%/<0.25), the researcher can draw the following conclusions: Intrinsic factors related to the incidence of pneumonia are the administration of vitamin A (OR=4.56; 95% CI=1.81-11.49; p value=0.001) and exclusive breastfeeding (OR=0.35; 95% CI=0.11-1.09; p value=0.072); The related extrinsic factor was education (OR=2.47; 95% CI=1.51-5.32; p value=0.020). The most influential risk factors for the incidence of pneumonia were the administration of vitamin A (OR=4.56; 95% CI=1.81-11.49; p value=0.001); Spatial Analysis the incidence of toddlers pneumonia cases in Banda Raya District was mostly found in Peunyerat village with 19 cases, and the least in Lhong Cut with 1 case.

References

Adawiyah R., 2012. Faktor-faktor yang Berpengaruh terhadap Kejadian Pneumonia pada Balita di Puskesmas Susunan Kota Bandar Lampung Tahun 2012, *YARSI Medical Journal*, 24(1), pp.51-68.

Chou, C., Shen, C., Chen, S., Chen, H., Wang, Y., Chang, W., Chang, Y., Chen, W., Huang, C., Kuo, C., Li, M., Lin, J., Lin, S., Ting, S., Weng, T., Wu, P., Wu, U., Lin, P., Lee, S.S., Chen, Y., Liu, Y., Chuang, Y., Yu, C., Huang, L., & Lin, M., 2019. Recommendations and Guidelines for the Treatment of Pneumonia in Taiwan. *Journal of Microbiology, Immunology and Infection*, 52(1), pp. 172-199.

DiBardino, D.M., & Wunderink, R.G., 2015. Aspiration Pneumonia: A Review of Modern Trends. *Journal of Critical Care*, 30(1), pp.40-48.

Dinkes Banda Aceh, 2016. *Profil Kesehatan Kota Banda Aceh tahun 2016*, Banda Aceh: Dinas Kesehatan Kota Banda Aceh, 2016.

Fatichaturrachma S., Suhartono S. & Dharminto D., 2016. Hubungan Lingkungan Fisik Rumah dengan Kejadian Penyakit Pneumonia pada Balita di Wilayah Kerja Puskesmas Pekayon Jaya Kota Bekasi, *Jurnal Kesehatan Masyarakat (e-Journal)*, 2016;4(5):187-195.

Gattinoni, L., Chiumello, D., & Rossi, S., 2020. COVID-19 Pneumonia: ARDS or not?. *Critical Care*, 24.

Jain, S., Self, W.H., Wunderink, R.G., Fakhran, S., Balk, R., Bramley, A.M., Reed, C., Grijalva, C.G., Anderson, E.J., Courtney, D.M., Chappell, J.D., Qi, C., Hart, E.M., Carroll, F., Trabue, C., Donnelly, H.K., Williams, D.J., Zhu, Y., Arnold, S.R., Ampofo, K., Waterer, G.W., Levine, M., Lindstrom, S., Winchell, J.M., Katz, J.M., Erdman, D., Schneider, E., Hicks, L.A., McCullers, J.A., Pavia, A.T., Edwards, K.M., & Finelli, L., 2015. Community-Acquired Pneumonia Requiring Hospitalization among U.S. Adults. *N Engl J Med*, 373, pp.415-427.

Giuliano, K.K., & Quinn, B., 2018. The Epidemiology of Nonventilator Hospital-acquired Pneumonia in the United States. *American Journal of Infection Control*, 46(3), pp.322-327.

Grief, S.N., & Loza, J.K., 2018. Guidelines for the Evaluation and Treatment of Pneumonia. *Primary Care: Clinics in Office Practice*, 45(3), pp. 485-503.

Koo, H.J., Lim, S., Choe, J., Choi, S., Sung, H., & Do, K., 2018. Radiographic and CT Features of Viral Pneumonia. *RadioGraphics*, 38(3).

Mandell, L.A., & Niederman, M.S., 2019. Aspiration Pneumonia. *The New England Journal of Medicine*, 380, pp. 651-663.

Mani, C.S., 2018. Acute Pneumonia and Its Complications. *Principles and Practice of Pediatric Infectious Diseases,* 2018, pp.238–249

Prina, E., & Torres, A., 2015. Community-acquired Pneumonia. *The Lancet*, 386(9998), pp. 1097-1108.

Ramirez, J.A., Wiemken, T.L., Peyrani, P., Arnold, F.W., Kelley, R., Mattingly, W.A., Nakamatsu, R., Pena, S., Guinn, B.E., Furmanek, S.P., Persaud, A.K., Raghuram, A., Fernandez, F., Beavin, L., Bosson, R., Fernandez-Botran, R., Cavallazzi, R., Bordon, J., Valdivieso, C., Schulte, J., & Carrico, R.M., 2017. Adults Hospitalized With Pneumonia in the United States: Incidence, Epidemiology, and Mortality. *Clinical Infectious Diseases*, 65(11), pp.1806–1812.

Restrepo, M.I., & Reyes, L.F., 2018. Pneumonia as a Cardiovascular Disease. *Respirology*, 23(3), pp.250-259.

Stephen, O., Sain, M., Maduh, U.J., & Jeong, D., 2019. An Efficient Deep Learning Approach to Pneumonia Classification in Healthcare. *Hindawi*, 2019.

Wei, X., Li, X., & Cui, J., 2020. Evolutionary Perspectives on Novel Coronaviruses Identified in Pneumonia Cases in China. *National Science Review*, 7(2), pp. 239–242.

WHO, 2018. *Acute Respiratory Infection Prevention and Control in Health Care Facilities.*

Zar, H.J., Andronikou, S., & Nicol, M.P., 2017. Advances in the Diagnosis of Pneumonia in Children. *BMJ*, 358.

Zhu, N., Zhang, D., Wang, W., Li, X., Yang, B., Song, J., Zhao, X., Huang, B., Shi, W., Lu, R., Niu, P., Zhan, F., Ma, X., Wang, D., Xu, W., Wu, G., Gao, G.F., & Tan, W., 2020, A Novel Coronavirus from Patients with Pneumonia in China, 2019. *The New England Journal of Medicine*, 382, pp. 727-733.