

### Supplemental Table 1 ICD-9 and ICD-10 codes used to capture influenza diagnoses

ICD-9 Influenza diagnosis codes	Diagnosis Description
487.0, 487.1, 487.8	Influenza with pneumonia or respiratory manifestations
488.0, 488.01, 488.8, 488.81, 488.02, 488.82, 488.09, 488.1, 488.19, 488.89, 488.11, 488.12, 487.8	Influenza due to identified avian, novel, or seasonal influenza virus
ICD-10 Influenza diagnosis codes	
J09, J09.X, J09.X1, J09.X2, J09.X3, J09.X9	Influenza due to certain identified influenza viruses
J10, J10.0, J10.00, J10.01, J10.08, J10.1, J10.2, J10.8, J.10,81, J10.82, J10.83, J10.89	Influenza due to other identified influenza viruses
J11, J11.0, J11.00, J11.08, J11.1, J11.2, J11.8, J11.81, J11.82, J11.83, J11.89	Influenza due to unidentified influenza virus

### Supplemental Table 2 ICD-9 and ICD-10 codes used to capture influenza-like illness

ICD-9 Influenza-like Illness Codes	Diagnosis Description
079.99	Unspecified viral infection
382.9	Unspecified otitis media
460, 461.9, 465.8, 465.9	Acute nasopharyngitis, sinusitis, or upper respiratory infections, unspecified
466.0	Acute bronchitis
486	Pneumonia, organism unspecified
488.0, 488.01, 488.8, 488.81, 488.02, 488.82, 488.09, 488.1, 488.19, 488.89, 487.0, 487.1, 488.11, 488.12, 487.8	Influenza due to identified novel, avian, or seasonal influenza virus
490	Bronchitis, not specified as acute or chronic
786.2, 780.6, 780.6	Cough, fever, other physiologic disturbance of temperature regulation, and unspecified fever
ICD-10 Influenza-like Illness Codes	
B97.89	Other viral agents as the cause of disease classified elsewhere
H66.9, H66.90, H66.91, H66.92, H66.93	Otitis media, unspecified
J00, J01.9, J01.9, J01.90, J06.9	Acute nasopharyngitis, acute sinusitis, acute upper respiratory infection, unspecified
J09, J09.X, J09.X1, J09.X2, J09.X3, J09.X9, J10, J10.0, J10.00, J10.01, J10.08, J10.1, J10.2, J10.8, J.10,81, J10.82, J10.83, J10.89, J11, J11.0, J11.00, J11.08, J11.1, J11.2, J11.8, J11.81, J11.82, J11.83, J11.89, J12.89, J12.9,	Influenza due to identified novel, avian, or seasonal influenza virus
J18, J18.1, J18.8, J18.9	Other or unspecified viral pneumonia Pneumonia unspecified organism

J20.9, J40

Acute bronchitis from unspecified organism, or bronchitis not specified as acute or chronic  
Cough or fever, unspecified

R05, R50.9

**Supplemental Table 3 ICD9 and ICD 10 Codes used to capture asthma and asthma attack diagnosis**

**Asthma Diagnosis ICD 9 and ICD 10 Codes**

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493, 493.0, 493.00, 493.01, 493.02, 493.1, 493.10, 493.11, 493.12, 493.2, 493.20, 493.21, 493.22, 493.8, 493.81, 493.82, 493.9, 493.90, 493.91, 493.92

**Asthma Attack Diagnosis ICD 9 and ICD 10 Codes**

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493.01, 493.02, 493.11, 493.12, 493.21, 493.22, 493.91, 493.92

**Supplemental Table 4 Table 1. ICD9, ICD10, CPT, and NDC codes used to capture influenza vaccination**

**Influenza Vaccination ICD 9 and ICD 10 codes**

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99.52, V0481, 3E01340, and 3E02340.

**Influenza Vaccination CPT codes**

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90686, 90688, 90672, 90682, 90685, 90687, 90662, 90656, 90658, 90653, 90674, 90661, Q2037, 90630, 90749, 90756, 90673, 90655, 90657, 90460, 90461, 90471, 90472, 90473, 90474, 90654, 90660, Q2034, Q2035, Q2036, Q2038, and Q2039.

**Influenza Vaccination NDC codes**

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33332-0010-01, 33332-0013-01, 33332-0014-01, 33332-0015-01, 33332-0016-01, 33332-0017-01, 33332-0018-01, 33332-0110-10, 33332-0113-10, 33332-0114-10, 33332-0115-10, 33332-0116-10, 33332-0117-10, 33332-0118-10, 33332-0316-01, 33332-0317-01, 33332-0318-01, 33332-0416-10, 33332-0417-10, 33332-0418-10, 66521-0000-01, 70461-0001-01, 70461-0002-01, 70461-0018-03, 58160-0879-52, 58160-0880-52, 58160-0881-52, 58160-0883-52, 58160-0898-52, 58160-0900-52, 58160-0901-52, 58160-0903-52, 58160-0905-52, 58160-0907-52, 42874-0012-10, 42874-0013-10, 42874-0014-10, 42874-0015-10, 42874-0016-10, 42874-0017-10, 42874-0117-10, 49281-0718-10, 62577-0613-01, 62577-0614-01, 63851-0612-01, 63851-0613-01, 70461-0200-01, 70461-0301-10, 70461-0418-10, 70461-0201-01, 70461-0318-03, 19515-0845-11, 19515-0850-52, 19515-0889-07, 19515-0890-07, 19515-0893-07, 19515-0891-11, 19515-0894-52, 19515-0895-11, 19515-0896-11, 19515-0898-11, 19515-0900-11, 19515-0901-52, 19515-0903-11, 19515-0908-52, 19515-0909-52, 19515-0912-52, 66019-0107-01, 66019-0108-10, 66019-0109-10, 66019-0110-10, 66019-0300-10, 66019-0301-10, 66019-0302-10, 66019-0303-10, 66019-0304-10, 66019-0305-10, 66521-0112-02, 66521-0112-10, 66521-0113-02, 66521-0113-10, 66521-0114-02, 66521-0114-10, 66521-0115-02, 66521-0115-10, 66521-0116-02, 66521-0116-10, 66521-0117-02, 66521-0117-10, 66521-0118-02, 66521-0118-10, 70461-0119-02, 70461-0119-10, 70461-0120-02, 70461-0120-10, 49281-0010-10, 49281-0010-25, 49281-0010-50, 49281-0011-10, 49281-0011-50, 49281-0012-10, 49281-0012-50, 49281-0013-10, 49281-0013-50, 49281-0014-50, 49281-0111-25, 49281-0112-25, 49281-0113-25, 49281-0386-15, 49281-0387-65, 49281-0388-15, 49281-0390-15, 49281-0392-15, 49281-0394-15, 49281-0396-15, 49281-0705-55, 49281-0707-55, 54868-6177-00, 54868-6180-00, 49281-0389-65, 49281-0391-65,

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**Supplemental Table 5 Bivariate correlation matrix of potential covariates**

	Avg Temp (Flood)	Avg Temp (Flu)	Relative Humidity (Flood)	Relative Humidity (Flu)	Absolute Humidity (Flood)	Absolute Humidity (Flu)	Flooding	Vacc Rate	Asthma Rate	Asthma Attack Rate	Pop Density	% Under 5	% Older 75	% Animal Production
Avg Temp (Flood)	1.00	0.49**	-0.52**	-0.51**	0.54**	0.25*	0.04	-0.30**	-0.04	-0.05	0.20*	0.31**	-0.33**	-0.27**
Avg Temp (Flu)	0.49**	1.00	0.15*	-0.24**	0.71**	0.90**	0.02	-0.29**	-0.34**	-0.34**	0.12	0.17*	-0.28**	-0.21*
Relative Humidity (Flood)	-0.52**	0.15*	1.00	0.38**	0.42**	0.32**	0.02	0.06	-0.16*	-0.17*	-0.19**	-0.22**	0.05	0.07
Relative Humidity (Flu)	-0.51**	-0.24**	0.38**	1.00	-0.23**	0.14*	0.03	0.17*	-0.14*	-0.13	-0.35**	-0.41**	0.34**	0.30**
Absolute Humidity (Flood)	0.54**	0.71**	0.42**	-0.23**	1.00	0.59**	0.05	-0.29**	-0.20**	-0.21**	0.03	0.12	-0.30**	-0.22**
Absolute Humidity (Flu)	0.25*	0.90**	0.32**	0.14*	0.59**	1.00	0.03	-0.24**	-0.43**	-0.43**	-0.01	-0.01	-0.17*	-0.12
Flooding	0.04	0.02	0.02	0.03	0.05	0.03	1.00	0.01	0.05	0.12	-0.17	-0.01	-0.14	0.07
Vacc Rate	-0.30**	-0.29**	0.06	0.17*	-0.29**	-0.24**	0.01	1.00	0.56**	0.47**	0.17*	-0.09	0.03	0.05
Asthma Rate	-0.04	-0.34**	-0.16*	-0.14*	-0.20**	-0.43**	0.05	0.56**	1.00	0.89**	0.28**	0.06	-0.21**	-0.28**
Asthma Attack Rate	-0.05	-0.34**	-0.17*	-0.13	-0.21**	-0.43**	0.12	0.47**	0.89**	1.00	0.33**	0.04	-0.08	-0.25**
Pop Density	0.20*	0.12	-0.19**	-0.35**	0.03	-0.01	-0.17	0.17*	0.28**	0.33**	1.00	0.59**	-0.50**	-0.71**
% Under 5	0.31**	0.17*	-0.22**	-0.41**	0.12	-0.01	-0.01	-0.09	0.06	0.04	0.59**	1.00	-0.53**	-0.57**
% Older 75	-0.33**	-0.28**	0.05	0.34**	-0.30**	-0.17*	-0.14	0.03	-0.21**	-0.08	-0.50**	-0.53**	1.00	0.82**
% Animal Production	-0.27**	-0.21*	0.07	0.30**	-0.22**	-0.12	0.07	0.05	-0.28**	-0.25**	-0.71**	-0.57**	0.82**	1.00

Avg: Average Temp: Temperature Vacc: Vaccination \* p < 0.05 \*\* p << 0.005

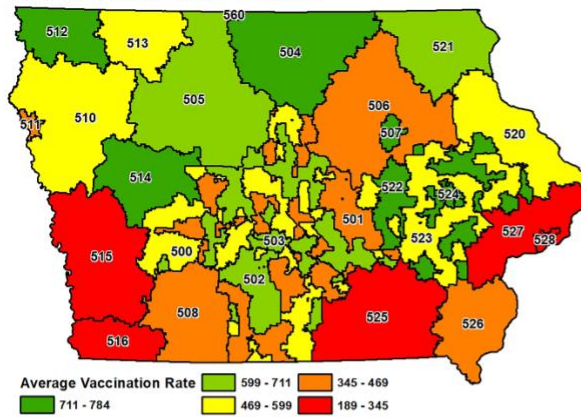
**Supplemental Table 6 Bayesian CAR model results using imputed environmental (set to 0) data and influenza diagnosis rates as the outcome**

<b>Variable</b>	<b>Mean</b>	<b>2.5% Quantile</b>	<b>97.5% Quantile</b>	<b>Gelman Diag.</b>	<b>Probability of risk &gt; 1</b>
Asthma Attack Rate	0.996	0.976	1.02	1.00	0.173
Vaccination Rate	1.00	1.00	1.00	1.00	≤0.001
Population Density	1.00	1.00	1.00	1.00	≤0.001
Percent in Animal Production	1.11	1.02	1.19	1.00	0.989
Average Absolute Humidity	1.56	0.889	2.77	1.00	0.941
Total Average Days Above Flood Stage	1.01	0.999	1.02	1.00	0.680

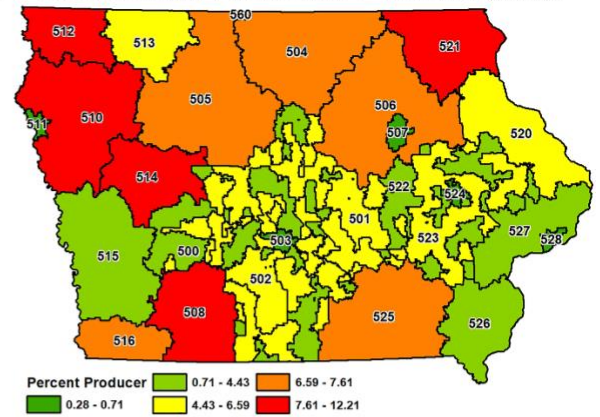
**Supplemental Table 7 Bayesian CAR model results using imputed environmental (impute) data and influenza diagnosis rates as the outcome**

<b>Variable</b>	<b>Mean</b>	<b>2.5% Quantile</b>	<b>97.5% Quantile</b>	<b>Gelman Diag.</b>	<b>Probability of risk &gt; 1</b>
Asthma Attack Rate	0.996	0.976	1.02	1.00	0.186
Vaccination Rate	1.00	1.00	1.00	1.00	≤0.001
Population Density	1.00	1.00	1.00	1.00	≤0.001
Percent in Animal Production	1.11	1.02	1.20	1.00	0.992
Average Absolute Humidity	1.58	0.903	2.77	1.00	0.947
Total Average Days Above Flood Stage	1.01	0.999	1.02	1.00	0.740

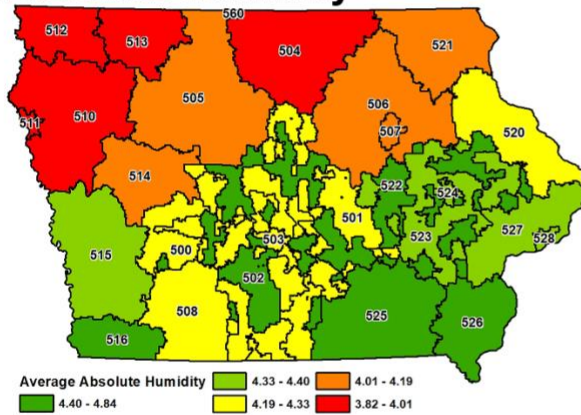
### A. Vaccination Rate



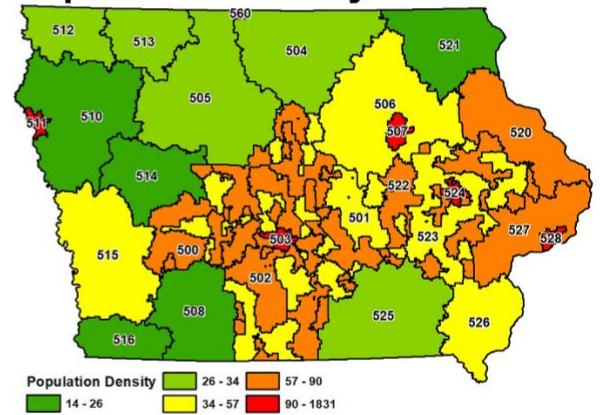
### B. Percent in Animal Production



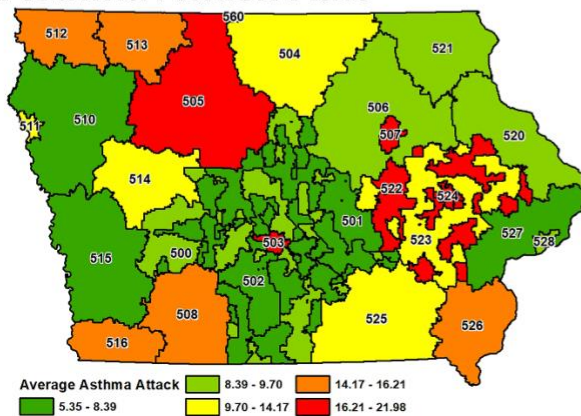
### C. Absolute Humidity



### D. Population Density



### E. Asthma Attack Rate



**Supplemental Figure 1 Maps of other covariates used in modeling process.** A) Vaccination Rates. Average vaccination per each three-digit ZCTA from 2007-2017. B) Percent of population working in Animal Production. Percent of each three-digit ZCTA total population that indicated Animal production as their primary vocation. C) Average Absolute Humidity. Average Absolute humidity from 2007-2017. D) Population Density. Population density for each three-digit ZCTA. E) Average Asthma Attack Rate. Average asthma attack rates per each three-digit ZCTA from 2007-2017.