Variables Associated with Critical Illness Among Clark County Residence Hospitalized with H1N1 Influenza A Virus during the 2009 Influenza Season.

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VARIABLES ASSOCIATED WITH CRITICAL ILLNESS AMONG CLARK COUNTY RESIDENTS HOSPITALIZED WITH H1N1 INFLUENZA A VIRUS DURING THE 2009 INFLUENZA SEASON.

By
Jonathan Hyatt

A thesis submitted in partial fulfillment of the requirements for the degree of Masters of Public Health
School of Community Health Science
The Graduate College
May 2012
THE GRADUATE COLLEGE

We recommend the thesis prepared under our supervision by

Jonathan Hyatt

entitled

Variables Associated with Critical Illness Among Clark County Residents Hospitalized with H1N1 Influenza A Virus During the 2009 Influenza Season

be accepted in partial fulfillment of the requirements for the degree of

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May 2012
Abstract:

Background: In 2009, a novel H1N1 Influenza A virus was detected in the population. Because it can potentially affect a different population than the influenza strains circulating for the past 35 years, it is critical for physicians, practitioners and public health organizations to understand who is susceptible to this disease, and which sub-populations are most likely to suffer critical illness. The objective of this study was to examine the factors unique to 2009 H1N1 infection, with the goal of finding the variables associated with ICU admission (Critical Illness) in the Clark County 2009 H1N1 patient.

Methods: Factors that were assessed in this retrospective (review of medical records) case-control study include: Heart Disease, Chronic Lung Condition, Cancer Treatment, Other Immunosuppressive Conditions, Metabolic Disease, Pregnancy, BMI, Age and Gender. These were tested in logistic regression analyses to determine factors that predict ICU admission.

Results: For the adult population (>17; n=341), “Age”, “Gender” and “Cancer in the last year” were the only variables that could be included in the final model. The Hosmer and Lemeshow Test indicated this model did not predict ICU admission (p<0.001). For the population “Females of Reproductive Age” (n = 83), the variables “Age” (p = 0.019; OR 1.1) and “Antiviral Treatment” (p = 0.008, OR 10.2) were found to be predictive of ICU admission. For the “Pediatric” population, no variables were found to be predictive of ICU admission.

Interpretation: Because of the unique nature of the 2009 H1N1 Influenza Pandemic the results of this study are inconclusive; it is hypothesized that physicians were being cautious during the 2009 H1N1 season due to the strain’s unknown pathogenicity/virulence, and that they hospitalized ‘healthy’ H1N1 positive patients with chronic diseases or conditions which were linked to severe illness for influenza patients during previous epidemics. This would make it impossible for a statistical analysis to differentiate between the two outcomes (ICU admission and non-ICU [Med-Surg]).
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**Background and Significance:**

Influenza is a respiratory illness caused by influenza viruses. There are many different types of influenza virus, typed A, B, and C. Type A influenza viruses are further sub-typed into categories based on the virus’s ability to adhere to cells in its host which is determined by the protein hemagglutinin (HA), and its ability to cause disease, determined by the enzyme neuraminidase (NA). This information, along with the year it was detected and the location of the laboratory that first isolated the virus gives a specific influenza virus its scientific name\(^1\) (Center of Disease Control and Prevention [CDC], 2010a). Often, there is an animal part of the name, which refers to the suspected vector for the virus’s movement from animal host to human host; this is not scientific taxonomy, it is a “common” name used by scientists and laypeople to describe the disease.

Influenza is the 6th most common cause of death in the United States (Turkington, & Ashby, 2007). It has been documented as far back as 600 B.C., and has been responsible for some of the most devastating infectious disease outbreaks in recorded history. In 1918-19, it is estimated that an H1N1 Influenza A virus pandemic killed 40-60 million people. In 1957 and 1968, pandemics of influenza A viruses killed millions (Turkington, & Ashby, 2007). More recently, starting in 1987, a strain of “Bird flu” (a.k.a., H5N1 Highly Pathogenic Avian Influenza A Virus) sparked concern because of its extreme pathogenicity – potentially killing, as one researcher declared, “a number approaching 100% [mortality]” (Tranpuz, Prabhu, Smith, & Baddour, 2004). Fortunately,\(^1\)

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\(^1\) A hypothetical example of this naming process is a virus that was identified in Melbourne, Australia, was an influenza A virus, originated in kangaroos, occurred in the year 2099, and in a laboratory cleaved neuraminidase 7 and adhered to hemagglutinin 4, would be referred to as Melbourne 2099 “Kangaroo” H7N4 Influenza A virus (CDC, 2010a).
this disease has not yet been able to pass from person to person; thus an epidemic was avoided (CDC, 2010b).

Most years there are not antigenic-shifts\(^2\); the strain of viruses circulating differs very little from what the population was exposed to the season before. For almost four decades, influenza has been so similar from year to year that entire generations of physicians and practitioners were taught what its symptoms are. However, symptoms differ from strain to strain and among those most susceptible to the disease (Webster, et al., 1992; Huether & McCance, 2004).

In 2009, a new swine originated H1N1 influenza A virus was detected in the population. By the time the pandemic was at its height, the CDC and the World Health Organization (WHO) estimated that 98% of those infected with influenza in that season were infected with 2009 H1N1 (CDC, 2010c). Because this virus was “new” in circulation, and shared the same HA and NA type as the deadly 1918 influenza virus, researchers worried that this virus would have different symptoms, strike different individuals, and be deadlier than normal seasonal influenza (Itoh, et al., 2009).

Typical influenza symptoms include: fever, headache, sore throat, body aches, fatigue, and depression. When the patient’s fever drops, on approximately the second or third day, the patient becomes extremely vulnerable to secondary infection in the lungs; thus, any individual with respiratory disease, (i.e., chronic obstructive pulmonary disease [COPD], asthma, cystic fibrosis) will be at higher risk for complications involving

\(^2\) Antigenic Drift is a point mutation in the genetic material of the organism (in this case the RNA of the virus); its virulence and pathogenicity will be very similar to the previous virus. This is usually the difference between seasonal strains of an influenza virus. An antigenic shift is the changing of an entire gene of the virus, making its pathogenicity and/or virulence (and/or HA/NA) potentially dramatically divergent from the original organism.
secondary bacterial infection. Other factors associated with complications are age (morbidity: age 6 months-18 years and 65+; mortality: 6 mo. - 5 yr. and 50+, especially 65+ in nursing homes or institutions), chronic heart/vascular conditions, metabolic conditions (including Diabetes Mellitus), chronic kidney problems, immunocompromise (AIDS, cancer in the last 12 months), any disease that makes it difficult to breath or swallow (i.e., spinal cord injuries, seizure disorder), or living in crowded conditions (prisoners or those in emergency housing) (Huether & McCance, 2004). Knowledge of these risk factors is useful for studying H1N1, as tests can be developed to determine if there are differences between recent seasonal influenza strains and H1N1; in addition, these variables were treated as “working hypothesized” risk factors by the CDC (CDCd, 2010).

**Specific Aims:**

The objectives of this study were to document the demographic characteristics of the hospitalized 2009 H1N1 patient and ICU patient populations and to develop a tool for health care providers to screen patients for risk factors associated with ICU admission.

The research questions addressed in this project are: 1) what are the demographic data regarding those who were hospitalized with 2009 H1N1, for both the ICU patient and the non-ICU patient? 2) What pre-existing conditions contributed to admission into the ICU for this disease? With this information, we can inform the public as to who is at risk; we can inform the Southern Nevada Health District (SNHD) for whom it should
prioritize vaccinations; and we can create a checklist for the physician and practitioners for screening influenza patients to prevent complications.

This study used existing data from medical records sent to the health district as part of a reportable disease investigation generated by the Southern Nevada Health District (SNHD) during the 2009 H1N1 season. The study populations were all of the people that were hospitalized with a positive influenza laboratory result during the 2009 H1N1 pandemic in Clark County. Data from the medical records were transferred to a spreadsheet before they were analyzed and converted into tables of demographic information. The same was done for the subpopulation of ICU admitted patients.

**Methods:**

Because this project involved the use of data obtained from human subjects, an application was submitted to and approved by the Institutional Review Board of UNLV. All data for hospitalized patients were sent to the Southern Nevada Health District (SNHD) Office of Epidemiology (OOE) by the hospitals to which the patient was hospitalized, either by mail, or via fax; These data included nursing progress notes, intake “face sheets” (demographic and billing information), intake summaries from physicians and nurses, laboratory results (both from the hospital laboratory and outside agencies such as Quest Diagnostic, the Southern Nevada Health Laboratory, Centers for Disease Control and Prevention, etc.), physician progress notes, and medication administration records. Disease Investigators (DIIS) and interns in the SNHD OOE input the data into a Microsoft Access questionnaire/database. The questionnaire was tailored to Clark County by the SNHD senior epidemiologist Brian Labus, using the template designed by the
CDC for 2009 H1N1 hospitalized influenza investigations. The CDC questionnaire included basic demographic questions (age, gender, pregnancy status) and chronic disease status (heart/lung, metabolic, neurological, immunocompromise).

The data were then transferred from Microsoft Access to Microsoft Excel as a spreadsheet, and proofed for obvious errors, cursory demographic information, and missing data. Missing data were then found by interns, who retrieved the information in the patient charts in the medical records department of the appropriate hospital, and input manually into a copy of the Excel dataset.

When the data were gathered and distilled into one complete document, the spreadsheet was again scanned for obvious errors and missing data. Any obvious data entry errors were fixed with review of the original medical records or a phone call to the Infection Control Practitioner (ICP) at each hospital. When data regarding a chronic disease or condition were not found, it was assumed that the patient was free of this disease.

With the database complete, the raw data were stripped of any patient identifiers (name, birthdates, admission date [this was changed to admission month], and release date [to be replaced with “length of stay”]) and locked with password protection. A copy of the dataset was made and used for changing nominal “string” data into dichotomous data (i.e., gender “male” and “female” were changed into male, 1 or 0, with 1 being male, and 0 being not male, or female). BMI was calculated with the CDC “Adult BMI calculator”, by manually imputing the data on height and weight. Once the data were correctly conditioned, they were then transferred into IBM PASW 19.0 (International
Business Machines Predicative Analytic Software 19.0, IBM, Inc., 2010) where demographic reports were run. As these data do not contain information on ethnicity, race, income level, education or any other demographic information except those listed below, we were limited to exploring demographics to only age, gender, chronic disease, and pregnancy status. The demographic information discussed in this study are:

- age distribution,
- age demographics,
- age distribution by gender,
- counts of ICU admission by age-by-gender,
- gender percentages,
- pregnancy percentages,
- pregnancy percentages by age category,
- pregnancy percentage admitted to ICU,
- mortality percentages for pregnant patients,
- proportion of pregnant vs. non-pregnant ICU admission,
- length of stay demographics,
- length of stay by age category-and-gender,
- count and percentages of chronic disease in the sample population,
- count and percentages of ICU admission for each chronic disease,
- count and percentages of those with at least one chronic disease,
- ICU admission by count and percentages for the population with at least one chronic disease,
- ICU admission by BMI category.
After the demographic information was reviewed and proofread, three multiple logistic regression analyses were performed (Adult, Pediatric, Women of Reproductive Age).

To determine initially which variables should be included in the logistic regression analyses, crude analyses (one variable per model) were performed for all chronic diseases, age, BMI, Severity Index, and Antiviral Treatment Status, with ICU admission as the dependent variable. The Severity Index and chronic diseases were examined, despite being mutually exclusive for use in a final adult model, because it was possible that individual chronic diseases would be statistically significant while the severity index was not; or, if the severity index was significant, but two or more collinear chronic diseases were also significant, the severity index could be used in the model to minimize multicollinearity.

For the crude analyses, inclusion into a final model would mean that both the “Omnibus Model Chi-Square” test and the independent variable specific p-value within the test would have to be p =<.10; the rationale behind this decision was twofold: it is accepted by statisticians that regression models with greater numbers of independent variables that truly explain the outcome variable are more robust, as each variable is likely to augment the contribution of other independent variables in the model, thus: 1) By adding marginally significant variables, one would tend to increase the models R-square (its percentage of explaining variability the outcome variable); 2) Models with less independent variables (like our one independent or “crude” analysis) would thus be more likely to have a “not statistically significant” finding despite being significant (Type I error); by doubling the size of the “net” (expanding our “alpha” to .10), we would be
increasing the likelihood of including a higher number of truly significant variables into the final model.

Age and BMI (as interval, not categorical data) were tested for outliers\(^3\), Leverage values, Cook’s D, studentized residuals and DF Beta values.

Before the study was initiated, the authors hypothesized that age, BMI, chronic respiratory diseases, and pregnancy would be predictive of ICU admission for the 2009 H1N1 patient, as these were known risk factors for severe illness in previous influenza A epidemics.

**Findings:**

*Demographics:*

*Age Demographics; Hospitalized Population:* The ages of cases ranged from less than one year of age (referred to as ‘0’) to 84 years old, with a mean age of 37.5, and standard deviation of 21.8. Of the 424 patients, 229 were female (54%) and 195 were male (46%). The counts per age category for males and females appeared to be approximately normally distributed, with the exception of children under four years old (zero to four), which had more hospital admissions than the other three ‘17 and under’ age categories combined (Table 1).

*Age, Pediatrics:* For the population age 17 or under, there were 32 male hospitalizations under four, but just 22 for ages 5-19. There were 19 females under four

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\(^3\) Outliers were screened within the statistical test and flagged if the case residual value fell over 2 standard deviations from the model (Pallant, J., 2007).
hospitalized and 20 for ages 5-19. Of the 51 patients less than four years old hospitalized, 62.8% of them were male (Table 1).

Length of stay, by age: 70% of those hospitalized stayed seven days or less (n=297); 13.9% of them stayed 8-14 days (n=59); 4.7% them stayed 15-21 days (n = 20); 5.7% of them stayed more than 21 days (n = 24) (Table 1). There were 24 patients missing length of stay data (5.7%). Length of stay was then broken down by gender, and then cross referenced with age (Table 1). For both males and females, the majority of the patients were hospitalized for seven or less days (males 135 out of 195 [69.2%]; females 162 out of 229 [70.7%]); the age distributions for the ‘seven or less days inpatient’ followed the pattern displayed for the age demographics: a spike of 0-4 year olds, and then a roughly normally distributed count of age groups, peaking at 50-54 and 55-59 years old for males, and 45-49 through 60–64 years old for females (Table 2). For both genders, the numbers of people in each age category dropped dramatically in the next length of stay category, 8-14 days. For males there were just 15 out of 195 (12.3%) with a peak at 45-50 through 55-60; and for females there were only 35 out of 229 (15%), peaking at 45-49 through 60-64. Again, there was a peak in children under five (3 out of 24, [12.5%]), but for males only; there were no female patients under four hospitalized for 8-14 days. For the next length of stay category, there was again a drop in total numbers; of males there were just 9 (4.6%), and for females there were 11 (4.8%). Interestingly, there was only one male patient admitted for 15-21 days (0.5%) but there were four females for that length of stay (1.8%). For females, there was a cluster of patients aged from 25 years old to 49 years old, with no patients aged 5 through 24, and none 50 & older. For male adults, there was no discernible cluster, with a steady average
of one per age category from age 20 until 60, with 30-34, 40-44, & 50-54 having no patients in those age groups, and 45-49 having two. With the last length of stay category, '21 days or more’, which were presumably the sickest patients, we find the numbers for both genders increase: males, 12 out of the 195 patients (6.2%) were in this category; for females, 12 out of 229 (5.2%). For females, the patients clustered above 30, with no cases aged zero through 29. For males, there was a cluster starting at 35 through 59, although of the nine in those age categories there was a dramatic spike at 55-59 with five cases hospitalized in that age group. No other age category had more than one case.

*Pregnancy:* There were 229 women in this study, of which 220 (96.1%) had data regarding their pregnancy status during their hospital stay. These cases were then analyzed by age category, and broken down by pregnancy status, i.e., pregnant or not (1 or 0). An obvious distribution of positive pregnancy emerged, ranging from ages 15-34; age group 15-19 (6 out of 33 pregnancies, or 18.2%), 20-24 (11, or 33%), 25-30 (8 or 24.2%) 30-34 (7, or 21.2%). There was one positive pregnancy in the category of 40-44 (3.0%) (Table 2).

*Chronic diseases:* Information was collected on eight chronic diseases: Immune suppressed conditions (e.g., AIDS, corticosteroid use; 20 positive cases or 4.7%), Asthma (n=85, 18.9%), Metabolic Disease (e.g., cystic fibrosis, diabetes; n=75, 17.7%), Chronic Heart disease (e.g., right/left sided heart failure, congestive heart failure; n=77, 18.2%), Lung ‘other’ (e.g., COPD, tuberculosis; n=67, 15.8%), Cancer in the Last Year (n=21, 5.0%), Neurological Disease (e.g., Alzheimer’s, seizures, Parkinson’s Disease; n=9, 2.1%) and/or “Other” chronic disease (i.e., any chronic disease not falling into the above categories; n=83, 19.6%). Of the 424 people hospitalized, all of the chronic diseases
were accounted for, with no missing values\textsuperscript{4} (Table 3). A count of “any chronic disease” was performed, and it was found that of the 424 cases which were counted, 277, or 65.3\%, had at least one chronic disease. Only 147 (34.7\%) did not have at least one chronic disease.

**Severity Index:** Because the diseases in this study are not mutually exclusive, it was suspected some variables would be collinear. Therefore, it was decided to include an index of chronic disease severity\textsuperscript{5}. This technique has been employed by other researchers for similar data (Moonie, et al., 2008). The traditional method for developing a severity index was to have zero and one conditions be equal to ‘1’, two and three conditions equal to ‘2’, and four or more conditions equal to ‘3’. It was decided that, as the purpose of this research project was to allow physicians to create a checklist with which they could screen patients, there should be a true ‘zero’ level included, which would be equal to the patient having no chronic disease. A simple count of the number of chronic diseases per person was performed. It was found that there was a maximum of four comorbid chronic diseases in this population. Therefore the scale was developed to encompass this range: zero chronic diseases would have a score of ‘1’, one and two would score ‘2’\textsuperscript{6}, and three or more would score ‘3’. Using this scale, a count for each category was performed: 147 (34.7\%) scored ‘1’ cases having no chronic disease, 232

\textsuperscript{4} During a chart review, it was assumed that if a disease was not mentioned, the patient did not have that disease.
\textsuperscript{5} The term Systems Count was derived from medicine, which counts the number of “system failures”, using that index as a predictor of mortality. Other disciplines have since developed similar indexes using chronic diseases as predictors of morbidity (e.g., mental health, recovery from surgery) or mortality (Huether & McCance, 2004).
\textsuperscript{6} It is common to have two systems effected by the same chronic disease, with one being secondary to the other (Huether & McCance, 2004), e.g., congestive heart failure and chronic lung infiltration; diabetes and peripheral vascular disease; vascular stenosis and cardiac hyperplasia; neurological disease and chronic lung infection; cancer and immune compromise; etc.
(54.7%) scored ‘2’, having one to two chronic diseases, and 45 (10.6%) scored ‘3’ having three or more chronic diseases (Table 3). Each gender followed this pattern: females had 74 (32.3%) score ‘1’, 129 (56.3%) scoring 2, and 26 (11.4%) scoring 3 (n=229); males had 73 (37.4%) score ‘1’, 103 (52.8%) score ‘2’, and 19 (9.7%) score ‘3’.

**Body Mass Index:** BMI is a height to weight ratio, used to evaluate a person’s obesity level. The BMI calculation is: \( \left( \frac{lbs}{[\text{inches}]^2} \right) \times 703 \). There are six BMI categories: Underweight (<18.5), Normal (18.5 – 24.9), Overweight (25.0-29.9), Obese (30-34.9), Morbidly Obese (35-39.9), and Extreme Obesity (40+). Of the hospitalized population, there were 267 (63.0%) cases with BMI data: 10 (2.4%) were underweight, 62 (14.6%) were normal, 68 (16.0%) were classified as overweight, 53 (12.5%) were classified as obese, 42 (9.9%) were classified as morbidly obese and 32 (7.5%) were classified as extremely obese (Table 3).

**Medical Surgical vs. ICU patient demographics:** There were 424 patients with hospital admission information listed in the database, and a total of 130 (30.7%) people admitted to the ICU and 294 (69.3%) who remained on the standard “medical/surgical” (Med-Surg) floor. (Table 5). The mortality rate for the ICU subpopulation was 39 (31.9%), as opposed to the Med-Surg subpopulation, which did not have any deaths (0%). Length of stay for these two groups were broken down into four categories: “1 to 7” days, “8-14”, “15-21” and “22+” (over 21) days.

For the adult population in the ICU (n=113), the lengths of stay counts were: 67 (59.3%), for 1-7 days, 20 (17.7%) for 8-14 days, 6 (5.3%) for 15-21 days, and 10 (8.8%) for 22+ days, with 10 (8.8%) missing data (Table 4). The 103 patients with data had a
minimum of 1 day and a maximum of 72 days as a patient, with a mean of 9.2 and a
standard deviation of 11.9 days. There were 36 fatalities in this group (31.9% of adult
ICU patients; 92.3% of all ICU deaths.

For the adult Med-Surg population (n=228), the range for length of stay for this
group was 1 to 65 days, with a mean of 6.7 and a standard deviation of 7.7 days (Table
4).

The ICU pediatric population (n=17) had a minimum of 1 day length of stay, and
a maximum of 26 days, with a mean of 6.5 and a standard deviation of 6.5 days (Table 4).

The pediatric Med-Surg population (17< years old; n=66) spent a minimum of 1
day and a maximum of 21 days as patients, with a mean of 5.2 and a standard deviation
of 3.9 days (Table 4). There were no deaths in this group.

*Chronic Diseases in the ICU population:*

There were 17 pediatric patients in the ICU; Table 3 summarizes the count and
proportion of chronic illnesses found in this population.

Of the adult ICU patients with BMI data (n=85), there were 2 patients who fell
into the underweight category (33.3% of all “underweight” patients hospitalized; 2.4% of
all adult ICU patients); 23 fell into the normal category, (37.3% “Normal”; 25.9% adult
ICU); 18 overweight (26.9% “Overweight”; 21.2% adult ICU); 16 obese (31.4“Obese”; 18.8%
adult ICU); 19 morbidly obese (45.2% of “Morbid Obesity”; 22.4% adult ICU); and 8 extremely obese patients (25.0% “Extreme Obese”; 9.4% adult ICU).
Because the CDC does not recommend using BMI data as a “diagnostic tool” on pediatric patients, these data were not collected for this subpopulation. In addition, since BMI numbers are impossible to use with pregnant women, BMI data were also not collected for this subpopulation.

There were 33 pregnancies among all women, with 30 being in the Med-Surg population, and 3 in the ICU. There were 28 adult Med-Surg pregnancies, and 3 adult ICU pregnancies (Table 2). There were 2 pediatric pregnancies (2.4% pediatric population; 100% of pediatric pregnancies; 6.06% of all pregnancies); there were no pediatric ICU pregnancies (0% pediatric population; 0% pediatric pregnancies; 0% all pregnancies).

ICU Severity Index: There were 130 people in the ICU, with 94 (72.3%) of them having at least one chronic disease. Only 36 (27.7% of all ICU patients) did not have any chronic diseases. The majority of ICU patients, 78 (60%), had one or two chronic diseases. Only 16 (12.3%) had more than two chronic diseases (Table 3).

Results of logistic regression analyses:

Adults: There was only one chronic disease, “Cancer in the last year”, that was significantly associated with ICU admission (p=0.003). All other chronic diseases were not statistically significant (p>0.05): Metabolic (p=0.678), Chronic Heart (p=0.884), Asthma (p=0.738), “Lung, Other” (p=0.115), Immunocompromised (p= 0.732), Neurological (Chi p=0.738), “Other Chronic” (p=0.935) and “Severity Index” (p= 0.311).

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7 The CDC BMI website states, “[For the pediatric patient] BMI is not a diagnostic tool.” (CDC 2011d).
The variables Age (individual p=0.024) and Gender (individual variable p <0.001) were also found to be statistically significant in predicting ICU admission.

A final multiple logistic regression analysis was performed using these three variables. The model was weighted by age. There were 341 adult cases in the model. There were no cases removed for values surpassing the thresholds for Cooks D values, Leverage values, DF Beta and Studentized residuals; there were no cases with missing data. The Omnibus Test of Model Coefficients, which is a Chi Sq. test to determine if the 2x2 table (ICU admittance observed and ICU admittance predicted) is highly correlated. The null hypothesis is that there will be no difference between the two tables. For this model, the Chi Sq. value was significant (p<0.001).

The Hosmer and Lemeshow Test is another “goodness of fit” Chi Sq. test that determines if there is a difference between the model’s predicted values\(^8\) and the observed values. The null hypothesis is that there will not be a difference; however, because this test is looking for differences between the model and observed values, to say our model is supported, we must fail to reject the null hypothesis (i.e., this model is adequately predicting ICU admission status). The Chi Sq. statistic for this test was 650.56 (p<0.001), therefore we reject the null hypothesis; Thus the model is not supported by this statistic; in other words, the goodness of fit tests indicate that this is not a statistically significant model\(^9\).

We looked at the Cox & Snell R Sq. and the Nagelkerke R Sq. statistics. Unlike the previous tests, these statistics do not indicate if the test is a good fit or not, but instead

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\(^8\) Where the Omnibus Test uses a 2 x 2 table to test the model with no variables against the model with variables, the Hosmer & Lemeshow test observed results and the model’s predictions.

\(^9\) For the sake of didactic thoroughness, the rest of the analysis was performed, despite the model not being statistically significant. These data will not be used to draw conclusions.
shows how much variability in the dependent variable the model explains, as a percentage. Since this is not a true linear regression model, the R Sq. value is approximated. For this model, the Cox & Snell R Sq. statistic was 0.054, and the Nagelkerke R Sq. statistic was 0.074; this indicates that this model explains somewhere between 5.4% and 7.4% of the variation in ICU admission. This means that, out of the 100% of the variables that can predict ICU admission in this population, this model only accounts for between 5.4-7.4% of the variables; the other 92.6% were not included in this model.

Within the final model, all three variables were found to be significant using a Wald\textsuperscript{10} test: Age (p<0.001), Gender (p<0.001) and “Cancer in the last year” (p<0.001) were found to contribute significantly in this model. For Age, the odds ratios (OR) was 1.007, meaning that for every year increase in age over 18, the likelihood of being admitted to the ICU went up by 1.01% (95% CI 1.005-1.01). For Gender, the OR was 1.785, meaning that being Male made it 1.785 times more likely for a patient to be admitted to the ICU (CI 1.668-1.911). The OD for “Cancer in the last year” was 4.342 (CI 3.739-5.043), meaning that having had cancer in the last year made it 4.34 times more likely that the patient would be admitted to the ICU.

\textit{Pediatric:} Crude analyses were performed on variables for cases under the age of 18 (n=83). Neither chronic disease nor the “Severity Index” were found to be statistically significant: “Immunosuppressed conditions” (p=0.596); Asthma (p=0.718); “Metabolic Diseases” (p=0.177); Cancer (p=0.302); “Other Chronic” (p=0.137); Severity Index”.

\textsuperscript{10} The Wald test looks at the significance of the beta coefficient in the model, by dividing the predicted beta by the standard error. This yields a chi sq.-like distribution, from which a probability can be found.
Because the variables "Lung (other)”, “Chronic Heart”, and Neurological did not have any ICU cases, tests were not run for these variables.

Age was found to be significant (p=0.074) at the 0.10 alpha level after removing 11 cases for exceeding the Cook’s D and Leverage thresholds which exceeded either DF Beta or a Studentized residual threshold (or both) (n= 72). Gender was not a significant predictor of ICU admission (p=0.844). “Antiviral Treatment” was also not found to be significant predictor or ICU admission (p=0.497).

Because there were no chronic diseases, antiviral treatment, and demographic variables other than Age to be found statistically significant for the pediatric population, Age is the only variable that can be used in this model, and it is not statically significant at the 0.05 alpha level (p=0.074).

Reproductive Age Females: For females between the ages of 14 and 45 (n=83), Age (p=0.011) and Pregnancy Status (p=0.001) were found to be significant at predicting ICU admission.

No chronic disease were found to be statistically significant for this population: “Immunosuppressed conditions”( p=0.411); Neurological (not enough cases to run an analysis); Asthma (p=0.524); “Metabolic Diseases” (p=0.552); “Chronic Heart” (not enough cases to run an analysis); “Lung (other)” (p=0.132); Cancer (p=0.112); “Other Chronic” (p=0.147). “Severity Index” ( p=0.103) was also not found to be significant.

For the final model, two variables were entered: Age, and “Pregnancy Status”. The model was significant (p< 0.001). The Hosmer and Lemeshow Test was not significant, which supported this model (p=0.690). The Cox & Snell R Sq. (R Sq. 0.267)
and the Nagelkerke R Sq. (0.384) tests show this model explains between 2.67% and 3.84% of the variance for the dependent variable. As above, this means that this model contains only 2.67% to 3.84% of the variables that can predict ICU admission for this population; 96.16% of the variables that could help predict ICU admission for this population were not included in this model.

The variable “Age” (p=0.019) was significant within the model. The variable “Pregnancy Status” (p=0.103) was not significant within the model. Age had an OR of 1.11, which indicates that as age in women over 14 increases by 1, the risk of admission into the ICU goes up by 1.11%.

This model’s sensitivity was 41.7%, and its specificity was 93.6%. Its predictive power positive was 71.4%, and its negative predictive value was 80.6%.

**Discussion & Conclusions:**

*Adults Discussion:* The adult population hospitalized in Clark County during the 2009-10 influenza season consisted of 341 people, 113 of them admitted to the ICU. This study has found that the only chronic conditions and case variables that predict ICU admission in crude analyses were, “Cancer in the last year” (p<0.001), Age (p=0.023) and Gender (p=0.026). Canadian researchers (Campbell, et al. 2010), analyzing 1479 Canadian medical records, found similar results regarding age, “… patients with a nonsevere [sic] outcome were younger than those admitted to the ICU,” but that gender, while appearing significant in crude analysis, “…the differences disappeared in the multivariate analysis,” and was not significantly associated with ICU admission. They also did not find any chronic diseases significant in their multiple logistic regressions, so
instead chose to interpret percentages and relative risk (RR) based on their demographic findings\(^{11}\) (Campbell et al., 2010). In another study, Zarychanski, et al. (2010), another Canadian research team, studying Manatoba, Canada’s influenza hospitalized population in 2009-10 (n=795), compared ICU patients to Med-Surg patients and influenza positive non-hospitalized cases. In their multiple logistic regression model, which included Age, Gender, Chronic Illness, and other demographic variables, they found that only “First Nations ethnicity was associated with increased severity of disease” and that chronic diseases, “…did not reach statistical significance,” in predicting ICU admission. In Norway, Bjorn et al. (2011), found only Hypertension (chronic elevated blood pressure) was significant in their multiple logistic regression model at predicting ICU admission for their adult population (n=182).

No other “adult” study was found which used logistic regression, multiple logistic regression, or multivariate linear regression\(^{12}\) analyses of these variables on ICU admission. Many other studies utilized RR, proportions and/or rates. This makes it difficult to compare this analysis with the larger pool of data. It is clear, however, from the 2880 cases analyzed by all of the studies listed above, including this study, that chronic diseases were not significant predictors of ICU admission in these populations.

The variables Gender and Age are not as unequivocal; Age was found significant in the largest study (Campbell, et al., 2010; n=1479), but only when looked at in a crude

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\(^{11}\) RR was not included in this analysis because it was felt that these data would only result in making an interpretation more difficult, as the purpose of this analysis is answering the question, “Which variables predict admission to the ICU”, not “What is the risk of ICU admission in someone with x condition.”

\(^{12}\) It would be possible to use linear regression on outcome variables if criticality was quantified into 5 or more categories; e.g., non-hospitalized flu positive (1), hospitalized flu positive(2), ICU (3), intubation with oxygen (4), ECMO/Mortality/Critical acute medical condition (i.e., heart attack, ARDS, septicemia, etc.) secondary to influenza(5).
model. Gender was found to be significant in the second largest study (Zarychanski, et al. 2010), but again, only in a crude analysis. The results of this study found Age, Gender and ‘Cancer in the last year’ to be significant in crude analysis, but the “adult only” multiple logistic model “Age, Gender and ‘Cancer in the last year’” was not significant. The demographic data describe the adult populations of Med-Surg and ICU patients: there are clearly higher rates in Med-Surg population for both genders in the 45-59 age group (25.2% Med-Surg, men) and 45-64 age groups (28.9% Med-Surg, women); men had a corresponding increase in ICU rates (17.5% in just the 50-54 and 55-59 age range), but women did not have the same spike in ICU rates in their two highest age ranges 45-49 and 50-54 which were only 6.5% combined.

**Adult Conclusions:** Because of the differences in study approaches, comparisons between this study and others are limited to only three variables: Age, Gender and ‘Cancer in the last year’. Age is highly correlated with many chronic diseases, both in the young (i.e., Cystic Fibrosis) and with the elderly (i.e., heart conditions) (Huether & McCance, 2004); in this way, it is possible that Age is serving as a surrogate for chronic disease in the model. Other sources speculate that the 1976 influenza vaccination conferred some protection for those who received it, 33 years before (McCullers, et al., 2010; Xing & Cardona, 2009); This could help explain the abrupt drop off of ICU admissions in both genders at certain ages. Also, it may be that this is truly a characteristic of this virus: its pathogenicity is such that it targets those with certain physical characteristics\(^{13}\), with all other variables being equal. To further complicate the situation, we cannot know for sure if, in fact, the Med-Surg patients in this population

\(^{13}\) The British Medical Journal (2010) reported that raised levels of the inflammation protein CRP, was associated with mortality in their study of 2009 H1N1 Influenza A in 55 hospitals in the United Kingdom.
were truly sick, or if they were being admitted because they had a disease with unknown
virulence and a “suspected risk factor for critical illness”. As Zarychanski et al. (2010)
stated, “… the presence of a medical comorbidity were significantly associated with
admission to hospital … [but] age, sex,… medical comorbidity, interval from onset of
symptoms to initiation of antiviral therapy, urban v. rural status and income quintile
group …” were not significantly predictive of hospitalized patients being admitted to the
ICU. Therefore, data gathered about the Med-Surg population cannot be used to draw
conclusions about this disease. We can, however, infer that those admitted into the ICU
were a true representation of a specific level of illness, i.e., they were truly sick. This
creates a problem for any test using these data: the control group, i.e., the Med-Surg
population, was not randomly selected and had a higher rate of high-risk conditions than
would be expected in an average influenza season, which would then be compared to the
ICU population; because logistic regression compares the condition rate in the case group
with the control group to see if cases had a statistically higher rate of the condition, it will
erroneously draw the conclusion that there is no difference. Zarychanski, et al., however,
used all Influenza Positive cases, hospitalized or not, and compared them to the ICU
population for just this reason: the population infected with influenza H1N1 were
infected for an unknown, but scientifically valid reason – they caught it naturally, and
thus cannot have a selection bias. Because this study used a lesser design, these data
cannot be generalized for any population (including Clark County) and for any other
time. Any conclusions that can be drawn can only be used to document this specific
season, when physicians were, most likely, admitting healthy people to the hospital, to
hopefully, ameliorate unknown risks.
In addition, it should be noted that not all of the chronic diseases had more than 20 cases within the adult ICU population (Immunosuppressed and Neurologic); because of the lack of power for those crude analyses, it is not known if they could have contributed significantly to the final model or not.

**Women of reproductive age – Discussion:** Pregnancy status, more than any other variable, was the most important variable for this population. Since pregnancy status was not significant in the model (although it was in the crude analysis), the analysis is very similar to the “Adult – Female” subpopulation, described above.

**Women of reproductive age – Conclusions:** Pregnancy status, along with being under the age four, may be the strongest predictors of hospital admission after severity of illness. The strongest evidence we have of this is that there were ten times as many Med-Surg pregnancies than there were ICU pregnancies (30:3). Louie, et al. (2009), found a rate of 22% pregnancies admitted to the ICU, or roughly 120% greater than this study. On the other hand, Campbell et al.(2010), found, “…pregnant women were not at increased risk of admission to ICU or death compared with the 92 non-pregnant women of reproductive age, but they did have a higher incidence of hospital admission without severe outcome (12.16 vs. 0.94 per 100,000 population) …”. Zarychanski et al. (2010) found little statistical difference between pregnant Med-Surg patients and pregnant ICU patients, citing an OR of 0.33 (.08 to 1.38); but, they found a much bigger difference between non-hospitalized pregnant influenza positive controls and pregnant ICU patients, with an OR of 3.64 (0.86 to 15.4). Clearly, the addition of an outpatient control group makes it possible to see what the “2009 H1N1 hospitalization bias” has obscured.
Pediatric – Discussion: There were no significant chronic diseases or demographic variables that predicted ICU admission for this population. However, this is a population skewed heavily toward infants and toddlers under four years old; 64.6% of all pediatric patients were under or equal to 4 years old. Of those, 84.3% were Med-Surg patients. However, there was a much higher rate of ICU admissions for this age group; there were more four and under ICU admissions (n=8), than there were for the rest of the pediatric population combined (n=7). Not only were they hospitalized at a higher rate, they had more severe outcomes. A closer look at the percentages of age categories for admissions to the ICU reveals that the under five percentage of 15.7% is actually under the rates for the older pediatric categories (5-9 years old, 20%; 10-14, 50%; 15-18, 33.3%). Also, infants less than 1 year of age account for 54.2% of all admissions for children under five years old, while having just 12% of the hospitalized patients in the ICU for that same group (Table 7).

Pediatric - Conclusions: The age “0” appears to have been hospitalized healthy, at a much higher rate than any other pediatric age group. This, again, will artificially negate the effect ICU admissions will have in a logistic regression model, by saturating the control group with the dependent variables.

Study – Conclusions: Age, Gender, and ‘Cancer in the last year’ in the Adult population were not significant predictors of ICU admission. Had this model been significant, the R-sq. values indicate that these three variables only account for between 5.4-7.4% of the variance of the dependent variable. This reveals there are many more dependent variables needed before we can use these data to create diagnostic algorithms.
As for the risks associated with ICU admission for those infected with the 2009 H1N1 Influenza A virus, the data supports that BMI, Age, Gender, Pregnancy, Chronic Diseases and Time to Antiviral treatment are associated with ICU admission. Studies utilizing RR are not directly comparable; they were asking what is associated with ICU admission and we were asking what predicted ICU admission. For the U.S. population, during the 2009 pandemic, association may have been a better question, as it is quicker to answer and easier to understand. Public health officials and medical personnel & administrators needed information; demographics & RR gave them a strong indication as to where to focus their energies. This may have been the reason for the overwhelming number of “demographic” studies. But RR and demographics can only sketch the outline of the populations. In order to understand the illness and the populations that are susceptible to critical illness, the interaction of the dependent variables must be determined. In this way, RR can be misleading as it does not take into account third (or more) variables, which may link the dependent and the independent variables, or the interactions between the two independent variables.\textsuperscript{14}

Because the analyses did not significantly predict ICU admissions for the adult and pediatric populations, and because the ‘Reproductive age female’ model only had an estimated R-sq. of 0.027-0.038, no screening tools could be developed that would predict ICU admission for physicians/practitioners.

\textsuperscript{14}In other words, RR is mono-dimensional, and only looks at a link between one variable (or one group of variables, i.e., a 45 y/o, Asian women in Houston) and an outcome; whereas multiple logistic regression models are holographic/multidimensional and take into account not only the independent/dependent variable connection, but the independent/independent/dependent relationship (which may be different than the simple, crude linkage); an example: Suppose a man smokes; RR can tell us he is X times more likely to develop lung cancer. But if this same individual jogs every day and eats a highly nutritious diet, his true risk will not be the same as the RR. Using multiple logistic/multivariate linear regression, we can tell how much less likely it is that this person will develop cancer than another individual who smokes and jogs but does not eat nutritious foods (or any other combination of these variables).
Limitations:

There were several limitations in this study. As noted above, the controls in this study were not randomly selected, and quite possibly reflected a systematic bias. In addition, it is possible that at some time during the 2009-10 influenza season hospitals may have stopped testing patients for Influenza, and instead relied on medical diagnosis. This seems like a logical conclusion to make, as the CDC stated (CDC, 2011), that 98% of all influenza cases in that season were H1N1; testing is expensive and, perhaps more importantly, there was a confirmed influenza pandemic at that time. If someone looked like they had the flu, said they felt like they had the flu, then most likely, they were infected with the H1N1 Influenza A virus. If this is true, a loophole was then created where physicians/hospitals could avoid the law requiring them to report the disease: there was no positive test. This would have had a definite impact on the number of cases in this study; because by the time hospitals would have decided to cease testing, the basic pathogenicity and virulence of the disease would have been known and perhaps physicians would have been less likely to hospitalize “healthy” people. This study could have used this information to compare early and late Med-Surg patients to determine if they were highly correlated (to determine if there was a difference between hospitalizations of groups early and late in the season). This would have been an initial step in verifying the reliability of this population.

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15 The SNHD Office of Epidemiology manager, Patricia Rowley contacted the many of the infection control practitioners in Clark County to ask if this was ever made a hospital policy. The majority did not reply, but those that did responded that it had never been a policy in their hospital.
This study was also limited by small sub-populations, especially for the pediatric sub-populations (e.g., pediatric, girl, in the ICU with Asthma). This makes it impossible to include rare conditions/populations in analyses, because the test will lack the power to adequately demonstrate a relationship.

Another limitation was the lack of BMI data for children. Although pediatric body mass indices are not diagnostically relevant in medicine, age percentiles for height and weight could have been substituted.

Also, the specificity and sensitivity of the tests used to determine influenza status were not used to interpret the data.

In addition, because of the chaotic nature of a “new” epidemic, new signs and symptoms may have caused physicians and practitioners to, at least initially, fail to test some patients with H1N1 influenza. Thus a portion of this population may have been underrepresented.

As stated before, because of the unique nature of those hospitalized with H1N1, the results of this analysis cannot be generalized to any other population, even Clark County after or before the 2009-10 influenza seasons.

**Recommendations:**

For future studies utilizing regression analyses, it may be helpful to divide the dependent variable into several hierarchical categorical variables, such as: non-hospitalized, hospitalized, supplemental oxygen, ICU, mechanical ventilation and/or sepsis, mortality. This way a linear regression model can be used, which would simplify
the analysis and interpretation, and could potentially increase the power of the statistical test.

It is also recommended that several independent variables be added: Bacterial pneumonia, antibiotic use, chest x-ray, sepsis, acute respiratory distress syndrome (ARDS), and separating pregnancy into trimester, as well as adding the variable “post-partum female”. It is also imperative that the specificity, sensitivity, predictive power positive and predictive power negative for the different types of influenza tests be known and factored into the analysis. In addition, the approximate time of onset of symptoms could be helpful, if paired with antiviral treatment dates. General demographic data would also be helpful: Race, education, location of residence, education, socioeconomic status, social interactions (i.e., preschool teacher, working/residing in a prison, having school age children/grandchildren, etc.), as this information could add another dimension to the statistical analysis. It would also be helpful, for physicians and midlevel practitioners, to have a report of clinical outcomes by demographics. Also, having access to medical records of past hospital influenza patients would be useful for distinguishing truly different signs, symptoms, pathogenicity and virulence. In addition, other studies included the percentage of health care workers, and it is assumed this would be valuable information for hospitals. But, above all, the single most important thing that can be done to improve any similar studies is to include a non-hospitalized control group.

This study also points out another potential avenue for research: the qualitative (narrative) and/or quantitative studies on physician actions and thought processes during a novel epidemic. This information has a potential to be of benefit to every future novel
epidemic, infectious or chronic, especially where there are shortages of medications, staff, hospital beds, monies, or other resources.

**Significance of this study:**

This study was the first of its kind for Las Vegas for this disease, and the 2nd in the U.S.. It also supports the conclusions drawn by every other study utilizing logistic regression analyses for this outcome (ICU). In addition, the results of this study suggest closer inspection of the conclusions regarding variables associated with severe illness for H1N1 infection in studies utilizing only relative risk (RR). In addition, this study revealed potential new avenues of research, such as the thought processes of physicians during a novel pandemic, and the quantitative difference in severity of illness between 2009 H1N1 and previous influenza seasons. Finally, these data can be used in future influenza research.
### Appendix A – Tables for Demographics

**Table 1. Age Groups of All Hospitalized H1N1 Patients in Clark County in 2009**

<table>
<thead>
<tr>
<th>Age</th>
<th>Frequency</th>
<th>%</th>
<th>Male</th>
<th>Female</th>
<th>1 to 7</th>
<th>8 to 14</th>
<th>15 to 21</th>
<th>22+</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 4</td>
<td>51</td>
<td>12</td>
<td>32</td>
<td>19</td>
<td>41</td>
<td>3</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>5 to 9</td>
<td>12</td>
<td>2.8</td>
<td>10</td>
<td>2</td>
<td>11</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10 to 14</td>
<td>12</td>
<td>2.8</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>4</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>15 to 19</td>
<td>18</td>
<td>4.2</td>
<td>6</td>
<td>12</td>
<td>14</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20 to 24</td>
<td>33</td>
<td>7.8</td>
<td>13</td>
<td>20</td>
<td>27</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>25 to 29</td>
<td>31</td>
<td>7.3</td>
<td>12</td>
<td>19</td>
<td>22</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>30 to 34</td>
<td>27</td>
<td>6.4</td>
<td>9</td>
<td>18</td>
<td>23</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>35 to 39</td>
<td>25</td>
<td>5.9</td>
<td>10</td>
<td>15</td>
<td>13</td>
<td>6</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>40 to 44</td>
<td>26</td>
<td>6.1</td>
<td>12</td>
<td>14</td>
<td>17</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>45 to 49</td>
<td>41</td>
<td>9.7</td>
<td>18</td>
<td>23</td>
<td>22</td>
<td>9</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>50 to 54</td>
<td>40</td>
<td>9.4</td>
<td>22</td>
<td>18</td>
<td>32</td>
<td>4</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>55 to 59</td>
<td>43</td>
<td>10.1</td>
<td>24</td>
<td>19</td>
<td>25</td>
<td>7</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>60 to 64</td>
<td>24</td>
<td>5.7</td>
<td>6</td>
<td>18</td>
<td>16</td>
<td>5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>65 to 69</td>
<td>14</td>
<td>3.3</td>
<td>4</td>
<td>10</td>
<td>8</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>70 +</td>
<td>27</td>
<td>6.4</td>
<td>11</td>
<td>16</td>
<td>19</td>
<td>5</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>424</td>
<td>100</td>
<td>195</td>
<td>229</td>
<td>297</td>
<td>59</td>
<td>20</td>
<td>24</td>
</tr>
</tbody>
</table>

*24 patients were missing length of stay information*
Table 2. Female Age Groups by Length of Stay & Pregnancy Count by Age Group: Female Patients Hospitalized with 2009 H1N1 influenza A infections in Clark County during the 2009-10 Influenza Season

<table>
<thead>
<tr>
<th>Age</th>
<th>Females Length of stay (Days) Count (% Female in Age/Length of Stay Category)*</th>
<th>Pregnancy Status Count</th>
<th>Pregnant in ICU</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 7</td>
<td>14 (34.1%) 0 (0.0%) 4 (80%) 0 (-)</td>
<td>19 0 0</td>
<td></td>
</tr>
<tr>
<td>8 to 14</td>
<td>2 (18.2%) 0 (0.0%) 0 (-)**</td>
<td>2 0 0</td>
<td></td>
</tr>
<tr>
<td>15 to 21</td>
<td>4 (57.1%) 2 (50.0%) 0 (-) 0 (0%)</td>
<td>6 0 0</td>
<td></td>
</tr>
<tr>
<td>22 +</td>
<td>10 (71.4%) 1 (50.0%) 0 (-) 0 (-)</td>
<td>6 6 0</td>
<td></td>
</tr>
<tr>
<td>5 to 9</td>
<td>16 (59.3%) 4 (100.0%) 0 (0%) 0 (0%)</td>
<td>9 11 0</td>
<td></td>
</tr>
<tr>
<td>10 to 14</td>
<td>15 (68.2%) 1 (33.3%) 1 (50%) 0 (-)</td>
<td>11 8 2</td>
<td></td>
</tr>
<tr>
<td>15 to 19</td>
<td>14 (60.9%) 2 (100.0%) 2 (100%) 0 (-)</td>
<td>11 7 1</td>
<td></td>
</tr>
<tr>
<td>20 to 24</td>
<td>8 (61.5%) 3 (50.0%) 0 (0%) 2 (66.7%)</td>
<td>15 0 0</td>
<td></td>
</tr>
<tr>
<td>25 to 29</td>
<td>8 (47.1%) 2 (66.7%) 1 (100%) 1 (50%)</td>
<td>13 1 0</td>
<td></td>
</tr>
<tr>
<td>30 to 34</td>
<td>13 (59.1%) 5 (55.6%) 3 (60.0%) 2 (60%)</td>
<td>23 0 0</td>
<td></td>
</tr>
<tr>
<td>35 to 39</td>
<td>16 (50.0%) 1 (25.0%) 0 (-) 1 (50%)</td>
<td>18 0 0</td>
<td></td>
</tr>
<tr>
<td>40 to 44</td>
<td>12 (48.0%) 4 (57.1%) 0 (0%) 3 (37.5%)</td>
<td>19 0 0</td>
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</tr>
<tr>
<td>45 to 49</td>
<td>13 (81.3%) 4 (80.0%) 0 (0%) 0 (-)</td>
<td>18 0 0</td>
<td></td>
</tr>
<tr>
<td>50 to 54</td>
<td>6 (75.0%) 3 (100.0%) 0 (0%) 1 (100%)</td>
<td>10 0 0</td>
<td></td>
</tr>
<tr>
<td>55 to 59</td>
<td>11 (57.9%) 3 (100.0%) 0 (-) 2 (66.7%)</td>
<td>16 0 0</td>
<td></td>
</tr>
<tr>
<td>60 to 64</td>
<td>162 (54.5%) 35 (59.3%) 11 (55%) 12 (50%)</td>
<td>196 33 3</td>
<td></td>
</tr>
</tbody>
</table>

*Eight Individuals were missing length of stay information.
** This indicates that there were no patients in this age/length of stay category, either male or female.
Table 3. Count and Percent of Chronic Disease, Severity Index and BMI for All Patients & ICU Patients

<table>
<thead>
<tr>
<th>Condition</th>
<th>Count of Condition</th>
<th>% Of Med-Surg Patients</th>
<th>% Of Condition All Patients</th>
<th>Count of Condition</th>
<th>% Of ICU Patients</th>
<th>% Of Condition All Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immunosuppressed Condition</td>
<td>20</td>
<td>4.7%</td>
<td>76.9%</td>
<td>6</td>
<td>4.6%</td>
<td>23.1%</td>
</tr>
<tr>
<td>Asthma</td>
<td>85</td>
<td>20.0%</td>
<td>77.3%</td>
<td>25</td>
<td>19.2%</td>
<td>22.7%</td>
</tr>
<tr>
<td>Metabolic Disease</td>
<td>75</td>
<td>17.7%</td>
<td>73.5%</td>
<td>27</td>
<td>20.8%</td>
<td>26.5%</td>
</tr>
<tr>
<td>Chronic Heart</td>
<td>77</td>
<td>18.2%</td>
<td>76.2%</td>
<td>24</td>
<td>18.5%</td>
<td>23.8%</td>
</tr>
<tr>
<td>Lung: Other</td>
<td>67</td>
<td>15.8%</td>
<td>71.3%</td>
<td>27</td>
<td>20.8%</td>
<td>28.7%</td>
</tr>
<tr>
<td>Cancer Last Year</td>
<td>21</td>
<td>5.0%</td>
<td>61.8%</td>
<td>13</td>
<td>10.0%</td>
<td>38.2%</td>
</tr>
<tr>
<td>Other Chronic</td>
<td>83</td>
<td>19.6%</td>
<td>75.5%</td>
<td>27</td>
<td>20.8%</td>
<td>24.5%</td>
</tr>
<tr>
<td>Neurological Disease</td>
<td>9</td>
<td>2.1%</td>
<td>75.0%</td>
<td>3</td>
<td>2.3%</td>
<td>25.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Severity Index</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No Chronic Diseases (1)</td>
<td>147</td>
<td>34.7%</td>
<td>81.7%</td>
<td>33</td>
<td>27.7%</td>
<td>18.3%</td>
</tr>
<tr>
<td>One to Two Chronic Conditions (2)</td>
<td>232</td>
<td>54.7%</td>
<td>74.8%</td>
<td>78</td>
<td>60.0%</td>
<td>25.2%</td>
</tr>
<tr>
<td>Three or More Chronic Conditions (3)</td>
<td>45</td>
<td>10.6%</td>
<td>73.8%</td>
<td>16</td>
<td>12.3%</td>
<td>26.2%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Body Mass Index</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Obesity</td>
<td>32</td>
<td>7.5%</td>
<td>80.0%</td>
<td>8</td>
<td>9.2%</td>
<td>20.0%</td>
</tr>
<tr>
<td>Morbid Obesity</td>
<td>42</td>
<td>9.9%</td>
<td>68.9%</td>
<td>19</td>
<td>21.8%</td>
<td>31.1%</td>
</tr>
<tr>
<td>Overweight</td>
<td>68</td>
<td>16.0%</td>
<td>79.1%</td>
<td>18</td>
<td>20.7%</td>
<td>20.9%</td>
</tr>
<tr>
<td>Obesity</td>
<td>53</td>
<td>12.5%</td>
<td>75.7%</td>
<td>17</td>
<td>19.5%</td>
<td>24.3%</td>
</tr>
<tr>
<td>Normal</td>
<td>62</td>
<td>14.6%</td>
<td>77.5%</td>
<td>18</td>
<td>20.7%</td>
<td>22.5%</td>
</tr>
<tr>
<td>Underweight</td>
<td>10</td>
<td>2.4%</td>
<td>83.3%</td>
<td>2</td>
<td>2.3%</td>
<td>16.7%</td>
</tr>
<tr>
<td>Missing</td>
<td>157</td>
<td>37.0%</td>
<td>78.5%</td>
<td>43</td>
<td>49.4%</td>
<td>21.5%</td>
</tr>
<tr>
<td>Total</td>
<td>242</td>
<td>57.1%</td>
<td>73.6%</td>
<td>87</td>
<td>100.0%</td>
<td>26.4%</td>
</tr>
</tbody>
</table>
Table 4. Length of Stay Categories by Med-Surg/ICU Admission Subdivided by Age Category

<table>
<thead>
<tr>
<th></th>
<th>1 to 7</th>
<th>8 to 14</th>
<th>15 to 21</th>
<th>22 +</th>
<th>Missing</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adult Med-Surg</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>165</td>
<td>29</td>
<td>9</td>
<td>13</td>
<td>12</td>
<td>228</td>
</tr>
<tr>
<td>Adult Med-Surg %</td>
<td>76.5%</td>
<td>12.7%</td>
<td>3.9%</td>
<td>5.7%</td>
<td>--</td>
<td>100.0%</td>
</tr>
<tr>
<td>Percent Adult</td>
<td>48.4%</td>
<td>8.5%</td>
<td>2.6%</td>
<td>3.8%</td>
<td>--</td>
<td>63.3%</td>
</tr>
<tr>
<td><strong>Pediatric Med-Surg</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>53</td>
<td>7</td>
<td>4</td>
<td>0</td>
<td>2</td>
<td>66</td>
</tr>
<tr>
<td>Ped. Med-Surg %</td>
<td>80.3%</td>
<td>10.6%</td>
<td>61.0%</td>
<td>0.0%</td>
<td>--</td>
<td>100.0%</td>
</tr>
<tr>
<td>Percent Pediatric</td>
<td>63.9%</td>
<td>8.4%</td>
<td>4.8%</td>
<td>0.0%</td>
<td>--</td>
<td>79.5%</td>
</tr>
<tr>
<td><strong>ICU</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult ICU</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>67</td>
<td>20</td>
<td>6</td>
<td>10</td>
<td>10</td>
<td>113</td>
</tr>
<tr>
<td>Adult ICU %</td>
<td>65.0%</td>
<td>19.4%</td>
<td>5.8%</td>
<td>9.7%</td>
<td>--</td>
<td>99.9%</td>
</tr>
<tr>
<td>Pediatric ICU</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>12</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>Percent</td>
<td>70.6%</td>
<td>5.9%</td>
<td>5.9%</td>
<td>17.6%</td>
<td>--</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Table 5. Count of All Medical Surgical and ICU Patients by Gender for Patients Hospitalized with 2009 H1N1 Influenza A Infections during the 2009-10 Flu Season

<table>
<thead>
<tr>
<th></th>
<th>Med-Surg</th>
<th>ICU</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Male</strong></td>
<td>127</td>
<td>68</td>
<td>195</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>167</td>
<td>62</td>
<td>229</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>294</td>
<td>130</td>
<td>424</td>
</tr>
</tbody>
</table>
Table 6. Count and percentage of Chronic Disease and Severity Index for All Pediatric Patients (n = 83) & Pediatric ICU Patients (n = 17)

<table>
<thead>
<tr>
<th>Chronic Disease</th>
<th>Condition</th>
<th>Count of Condition</th>
<th>% of Pediatric w/ Condition</th>
<th>Count of Condition</th>
<th>% of Pediatric w/ Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Immunosuppressed Condition</td>
<td>3</td>
<td>3.6%</td>
<td>1</td>
<td>5.9%</td>
</tr>
<tr>
<td></td>
<td>Asthma</td>
<td>12</td>
<td>14.5%</td>
<td>2</td>
<td>11.8%</td>
</tr>
<tr>
<td></td>
<td>Metabolic Disease</td>
<td>4</td>
<td>4.8%</td>
<td>2</td>
<td>11.8%</td>
</tr>
<tr>
<td></td>
<td>Chronic Heart</td>
<td>3</td>
<td>3.6%</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td></td>
<td>Lung: Other</td>
<td>2</td>
<td>2.4%</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td></td>
<td>Cancer Last Year</td>
<td>5</td>
<td>6.0%</td>
<td>2</td>
<td>11.8%</td>
</tr>
<tr>
<td></td>
<td>Other Chronic</td>
<td>22</td>
<td>26.5%</td>
<td>7</td>
<td>41.2%</td>
</tr>
<tr>
<td></td>
<td>Neurological Disease</td>
<td>3</td>
<td>3.6%</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Severity Index</td>
<td>No Chronic Diseases (1)</td>
<td>45</td>
<td>54.2%</td>
<td>6</td>
<td>35.2%</td>
</tr>
<tr>
<td></td>
<td>One to Two Chronic Conditions (2)</td>
<td>36</td>
<td>43.4%</td>
<td>11</td>
<td>64.7%</td>
</tr>
<tr>
<td></td>
<td>Three or More Chronic Conditions (3)</td>
<td>2</td>
<td>2.4%</td>
<td>0</td>
<td>0.0%</td>
</tr>
</tbody>
</table>
**Table 7.** Count of Med-Surg and ICU Patients for Pediatric Ages, by Year of Age.

<table>
<thead>
<tr>
<th>Age of case</th>
<th>AdmitICU 0</th>
<th>AdmitICU 1</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>25</td>
<td>3</td>
<td>28</td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>13</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>16</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>17</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>66</td>
<td>17</td>
<td>83</td>
</tr>
</tbody>
</table>
Appendix B: Office for Protection of Research Subjects Approval

Biomedical IRB – Expedited Review Approval Notice

NOTICE TO ALL RESEARCHERS:
Please be aware that a protocol violation (e.g., failure to submit a modification for any change) of an IRB approved protocol may result in mandatory remedial education, additional audits, re-consenting subjects, researcher probation, suspension of any research protocol at issue, suspension of additional existing research protocols, invalidation of all research conducted under the research protocol at issue, and further appropriate consequences as determined by the IRB and the Institutional Officer.

DATE: September 2, 2011
TO: Dr. Mark Buttner, Environmental and Occupational Health
FROM: Office of Research Integrity - Human Subjects
RE: Notification of IRB Action by /Charles Rasmussen/
Dr. Charles Rasmussen, Co-Chair
Protocol Title: Demographic information on 2009 hospitalized influenza cases in Southern Nevada from 4/27/09 - 12/31/09
Protocol #: 1004-3444M
Expiration Date: September 1, 2012

This memorandum is notification that the project referenced above has been reviewed and approved by the UNLV Biomedical Institutional Review Board (IRB) as indicated in Federal regulatory statutes 45 CFR 46 and UNLV Human Research Policies and Procedures.

The protocol is approved for a period of one year and expires September 1, 2012. If the above-referenced project has not been completed by this date you must request renewal by submitting a Continuing Review Request form 30 days before the expiration date.

Should there be any change to the protocol, it will be necessary to submit a Modification Form through ORI - Human Subjects. No changes may be made to the existing protocol until modifications have been approved by the IRB. Modified versions of protocol materials must be used upon review and approval. Unanticipated problems, deviations to protocols, and adverse events must be reported to the ORI – HS within 10 days of occurrence.

If you have questions or require any assistance, please contact the Office of Research Integrity - Human Subjects at IRB@unlv.edu or call 895-2794.
References:


Zarychanski, R., Stuart, T.L., Kumar, A., Douchette, S., Elliot, L. et al. (2010). Correlates of Severe Disease in Patients with Pandemic Influenza (H1N1) virus infection. Canadian Medical Association Journal, 182(3).
Curriculum Vitae

Jonathan Hyatt  
Las Vegas, NV  

E-Mail: hyattj3@unlv.nevada.edu  

Education

University of Nevada, Las Vegas (in progress) (1/08 – 5/12)  
Masters of Public Health (Epidemiology and Biostatistics)

Nevada State College (6/05 – 8/07)  
Bachelors of Science, Nursing.

Experience:

Graduate Assistant (1/12 - 5/12)  
Nevada State Public Health Lab, UNLV Branch  
University of Nevada Las Vegas

Epidemiology Intern (1/11 - 6/11)  
Southern Nevada Health District

Surveyor (4/11 – 6/11)  
University of Nevada Las Vegas/ Regional Transportation Commission

Epidemiology Intern (7/09 - 3/10)  
Southern Nevada Health District

Nurse Apprentice (6/06 – 9/06)  
Mountain View Hospital, Las Vegas, NV
Research Skills:

Computer: Microsoft Access db, Excel, and SPSS.

Quantitative Analysis: Epidemiological Statistical Techniques, Regression Analysis, Biostatistics, Non-parametric Analysis, Psychometrics.

Nursing: Chart reading, Medical/Nursing Procedures.

Infectious Agents: Public health techniques for identification, control and prevention of viral, bacterial, fungal, parasite and prion outbreaks.

Publications:


Presentations:

Hyatt, J. (2012). Variables Associated with Critical Illness Among Clark County Residents Hospitalized with H1N1 Influenza A Virus During the 2009 Influenza Season. Presented to the Southern Nevada Health District, Office of Epidemiology, 5/13/12.

Volunteer:

Southern Nevada Health District (3/10 – 6/10)
Epidemiology Intern

Southern Nevada Regional Emergency Rescue Association (1/04 – 1/05)
Emergency Medical Technician Intermediate

Crisis Call Center, (1/02 – 1/03)
Suicide Prevention Operator