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# Outbreak Investigation of Suspected Influenza in Makoni District of Manical and Province, Zimbabwe

**Innocent Chamusingarevi**
Health Promotion Officer, Ministry of Health and Child Care, Zimbabwe
**Maxwell Mhlanga**
Lecturer and D.Phil Fellow, University of Zimbabwe College of Health Sciences, Zimbabwe
**Augustine Ndaimani**
Lecturer and D.Phil Fellow, University of Zimbabwe College of Health Sciences, Zimbabwe

***Abstract:***
*Introduction- An outbreak of suspected influenza was detected at Sangano clinic where most of the cases were coming from Mukuwapasi and ST Lukes primary schools which are 4 km and 3km respectively from the clinic. A total of 571 cases were reported and no deaths were reported. The source of infection was not known and this study was done to investigate risk factors associated with contracting the suspected influenza.*
*Methods and Materials- A descriptive cross sectional study design and an unmatched 1:1 case control were conducted where a case was any person who presented with signs and symptoms of flu with or without a viral positive test, but living in the surrounding area of Sangano. A control was any person residing in the same area who did not present the signs and symptoms of suspected influenza during the same period. An interviewer administered questionnaire was used to collect data*
*Results- A total of one hundred and ninety six participants (98 cases and 98 controls) were enrolled and the summaries of results are as follows. Risk factors associated with contracting suspected influenza at Sangano clinic include: Sharing a bed with someone with flu symptoms in the past 7 days (OR=2.85: CI=2.241-3.451), having a relative visiting in past 7 days with symptoms of flu (OR=2.93; CI=1.538- 5.434), greeting by shaking hands or hugging any person who was ill within the last 7 days (OR=3.26; CI=1.21 - 10.19), sharing clothes and bedding with a friend(OR=2.16; CI=1.28-7.46) and being a school resident (OR= 4.43; CI= 1.21- 10.19).*
*Discussion and conclusion – It was noted that lower knowledge levels among school children, coughing and sneezing at each other and greeting by shaking hands, hugging promoted the spread of suspected influenza. Health workers lacked skills in managing cases. A study by (Rabie,2006) also found out that Hand washing has been shown to reduce non-specific respiratory infection risk by 6% to 44% in various settings and was highly effective in preventing transmission of SARS (Fung, 2006).Therefore there is need for Health promotion officer to health education to school children and community to avoid close contact during outbreaks*

***Keywords:*** *Case-control, Cross –sectional, Influenza, Outbreak*

## 1. Introduction

Outbreaks are defined as any excess in the number of cases of disease that would normally be expected in a particular geographic area over a particular period of time (Center for Disease Control (CDC), 2005).Influenza outbreaks occur when a new strain of the influenza virus is transmitted to humans from another animal species. Species that are thought to be important in the emergence of new human strains are pigs, chickens and ducks (Nicholls, 2009) Influenza is transmitted by droplet, contact and airborne routes. Respiratory droplets are currently thought to be the main mode of transmission (Bridges, 2003). There is also some suggestion that influenza may spread through airborne aerosols that are expelled through coughing or sneezing or aerosol generating procedures such as bronchoscopy or intubation (Tellier, 2006).

However, the clinical impact of aerosol spread is thought to be low. Droplet transmission is assumed to be the main mode of transmission for influenza. Since, droplets travel only a short distance through the air, close contact with an infected person has been often cited as a risk for exposure and subsequent infection (Brankston, 2007).

On 1 November 2009, a worldwide update by the WHO stated that "199 countries and overseas territories/communities have officially reported a total of over 482,300 laboratory confirmed cases of the influenza pandemic H1N1 infection that included 6,071 deaths. By the end of the pandemic, there were more than 18,000 laboratory confirmed deaths from H1N1. Due to inadequate surveillance and lack of healthcare in many countries, the actual total of cases and deaths was likely much higher than reported. Experts, including the

WHO, have since agreed that an estimated 284,500 people were killed by the disease, about 15 times the number of deaths in the initial death toll (WHO, 2011).

As of 26 April 2011, an H1N1 pandemic preparedness alert has been issued by the World Health Organisation (WHO) for the Americas. The affected areas have included the Chihuahua region of Mexico where its severity and work load have been high. It was reported in 2011 that the current vaccine (California/7/2009) for H1N1 influenza might be losing its effectiveness. This point is all the more significant since it is the current virus target for the northern hemisphere's flu vaccine, and is the intended choice for the southern hemisphere. While the response to the 2009 H1N1 pandemic was an opportunity to show recent progress, avian influenza H5N1 outbreaks still pose a significant and ongoing global health threat. To sustain the gains made in the past years, a broad-based commitment to build and maintain influenza surveillance globally that is sustainable (and eventually self-sustainable) requires dedicated, annualized resources, staffing, long-term influenza surveillance, prevention and control, and pandemic preparedness activities as high priorities (WHO, 2012).

*1.1. Influenza Outbreak in Zimbabwe*

The first cases of Influenza A H1N1 in Zimbabwe were reported from Manicaland Province at a boarding school called Hillcrest where five (5) cases were confirmed H1N1 cases by real time Polymerase Chain Reaction (PCR). Since then, the following provinces have also reported cases: Harare, Mashonaland East and Midlands. The affected districts include: Harare urban, Chivhu, Marondera, Ruwa, Seke, Mutasa, Nyanga and Chirumhanzu and a total of 198 probable cases have been reported (CDC, 2009).

Makoni district is one of the seven districts in Manicaland province with a population projection of 272 109 and 54 health facilities. Makoni covers a surface of 8100km$^2$ and lies mostly in regions 1 to 4 (Zimbabwe Statistical Agency, 2012). Makoni district has a large resettlement area of both planned and unplanned resettlement. Rusape town is the town situated in the district.Sangano (ward 19) is one of 51 wards in Makoni district, Manicaland province. The ward has a target population of 8100 people. There are two primary schools in the ward and these schools are St Lukes and Mukuwapasi primary schools. Sangano clinic is the only clinic in the ward which is manned by two nurses and a nurse aide. Due to shortage of environmental technicians (EHT) in the district, there is only one EHT responsible for Sangano (Ward 19) and Nyahukwe ward (20).

**2. Materials and Methods**

An unmatched case-control study and a descriptive cross sectional study were employed. The study setting wasMukuwapasi and St Lukes primary schools of Sangano (ward 19) of Makoni district. The study population comprised of students and teachers at Mukuwapasi and St Lukes primary school. Medical records at Sangano clinic of Makoni district and some key informants employed in the Ministry of Health and Child Care (MOHCC) were utilised as sources of more information. In this study, **A case:** Any person who presented to Sangano Clinic with signs and symptoms of suspected influenza attending school or a teacher at St Luke or Mukuwapasi primary schools and residing at the school or surrounding areas from 16/09/2013 up to 27/09/2013 when data collection was done. **A control:** Any person who did not present with signs and symptoms of suspected influenza attending school or a teacher at St Luke's or Mukuwapasi primary schools and residing at the school or surrounding areas from 16/09/2013 up to 27/09/2013 when data collection was done .

The key informants were the District Medical officer, District Nursing officer, District Environmental health officer, District Health promotion officer, District Pharmacist, District Laboratory Scientist, District health information officer, two headmasters of Mukuwapasi and St Lukes Primary Schools and Health workers at Sangano Clinic.

Using Statcalc function of EPI Info Version 7 and calculating the sample size at 95% confidence level, 80% power and assuming exposure in the not ill group to be 29%, [hospitalized patients with2009 H1N1 influenza in the United States(Seema, 2009)], sample size was 98cases and 98 controls with a total sample size of 196. A line list of cases was used as the sampling frame to select cases. Random numbers were then generated using random number function of the calculator. Ppatients with corresponding numbers on the line list were included into the study until 98 cases are selected. Controls were conveniently selected from school children and teachers who were available at St Luke's and Mukuwapasi primary schools who did not suffer from suspected influenza during the same period.

A pre-test of the questionnaire and other tools were done at Denzva primary school in Makoni where there were no cases to test validity and reliability. An interviewer administered questionnaire (Consortium for the Standardization for Influenza Sero-epidemiology, 2011) was used to filter the developed questionnaire so as to elicit information from study participants on demographic characteristics, knowledge of signs and symptoms of the influenza, risk factors and behaviours associated with contracting suspected influenza. Medical records were reviewed to assess case management.

The Integrated Disease Surveillance and Response checklist was used to evaluate the district preparedness and response to the outbreak (WHO and MOHCC, 2009). A check list was used to assess resource availability at the hospital and environmental risk factors. School headmasters were interviewed as key informants to elicit information on knowledge of influenza and their response to the outbreak in schools.

Quantitative data was summarized and analyzed using Epi Info version 7 to generate frequencies and means of variables, calculate measures of association, odds ratios and their confidence intervals. Stratified analysis was carried out to control for confounding and assess for effect modification. Multivariate analysis was carried out to control for confounding and identify independent risk factors for contracting influenza at St Luke and Mukuwapasi. Qualitative data was coded and analyzed for content to support findings from the quantitative data.

Permission to carry out the study was sought from the Provincial Medical Director for Manicaland, The District Medical Officer and The District Education Officer for Makoni District. Informed written consent was sought from the two headmasters of the schools in place of parents of study participants. Confidentiality was assured and maintained throughout the study. Health education on prevention of spread of disease was given to study population.

## 3. Results

### *3.1. Socio-demographic Data*

The outbreak affected 570 people from 16/09/2013 to 05/ 10/2013 but no deaths have been reported. About 408 (71.7%) of cases came from the two primary schools, namely St Lukes and Mukuwapasi primary schools. Ninety eight (98) cases and 98 controls were interviewed. Majority (54.1% of cases and 50.0% of controls) was female, 96.9% of cases and controls were school children and the remaining percentage for cases and control were school teachers.Table 1 shows the demographic characteristics of cases and controls.

| | **Cases n=98 (%)** | **Controls n=98 (%)** | **P-Value** |
|---|---|---|---|
| **Sex** | | | |
| • Male | 45(45.9) | 49(50.0) | |
| • Female | 53(54.1) | 49(50.0) | 0.1817 |
| **Place of residence** | | | |
| • Villages | 91(92.9) | 80(81.6) | |
| • School | 7(7.1) | 18(18.4) | 0.014 |
| **Median age** | 10.5(Q1=9; Q3=13) | 12 (Q1=10; Q3=16) | |

*Table 1: Demographic characteristics of cases and controls, Mukuvapasi and St Lukes Schools 2013*

### *3.2. Knowledge of Influenza*

The researchers noted that there was a significant difference in knowledge levels between cases and controls and the P-values for three variables were less than 0.05 and they are statistically significant. Table 2 below shows the knowledge levels of study participants

| **Variable** | **Cases No. = 98 (%)** | **Controls No= 98 (%)** | **P value** |
|---|---|---|---|
| Prior to outbreak, any knowledge of influenza A | 56 (54.4) | 41 (44.6) | 0.183 |
| Influenza A is spread through coughing , sneezing, contact with sick person | 43 (41.7) | 62 (67.4) | 0.00034 |
| Knowledge of preventive measures of Influenza A | 28 (27.2) | 44(47.8) | 0,0029 |
| What to do when one gets infected | 43 (41.7) | 60 (65.2) | 0.00104 |

*Table 2: Knowledge of Influenza, among cases and controls at Mukuvapasi and St Lukes Primary school*

### *3.3. Distribution of Cases by Place*

The distribution of suspected influenza cases by place at Sangano clinic shows that the two primary schools and surrounding areas reported suspected cases of influenza from 16 September 2013 as shown on the spot map in Fig 1.

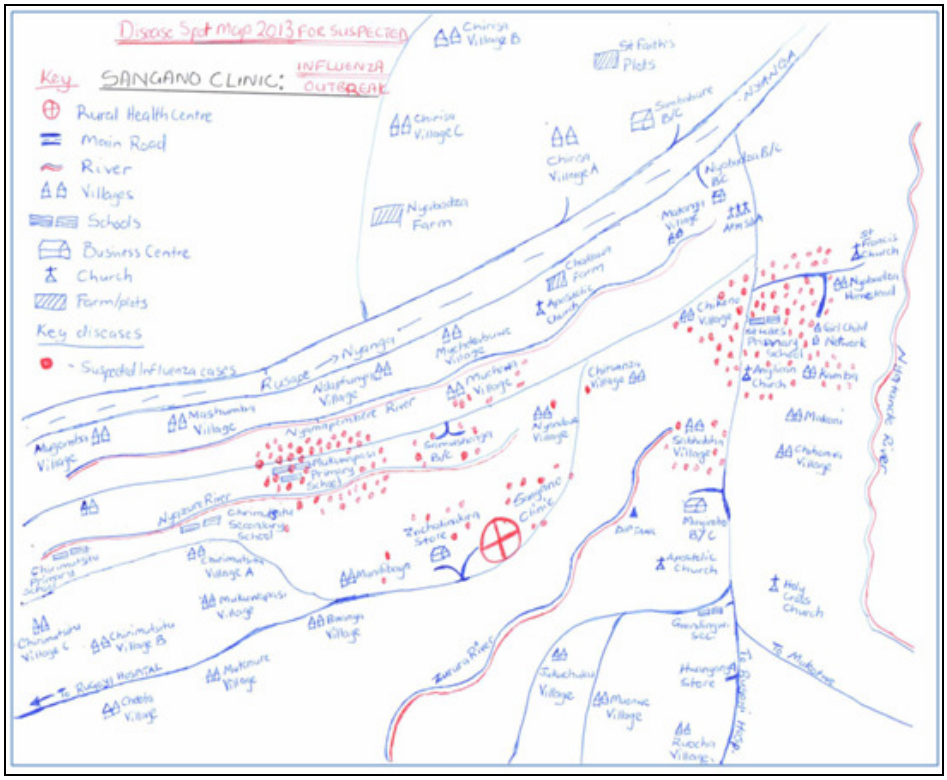


*Figure 1: Distribution of suspected influenza cases by place at Mukuvapasi and St Lukes primary school 2013*

*3.4. Distribution of Cases by Time at Sangano Clinic*

The index case was identified on 18 September 2013. On 19 September there were sharp increases and the cases decreases over the weekend because Sangano clinic is a council clinic which charges an amount of $1 per head. The community sends the children to clinic via school headmasters so that they cannot pay the user fees. The investigation was done on 26 and 27$^{Th}$ of September 2013 and there were still cases of suspected influenza reported. Fig 2 shows distribution of cases by time at Sangano clinic.

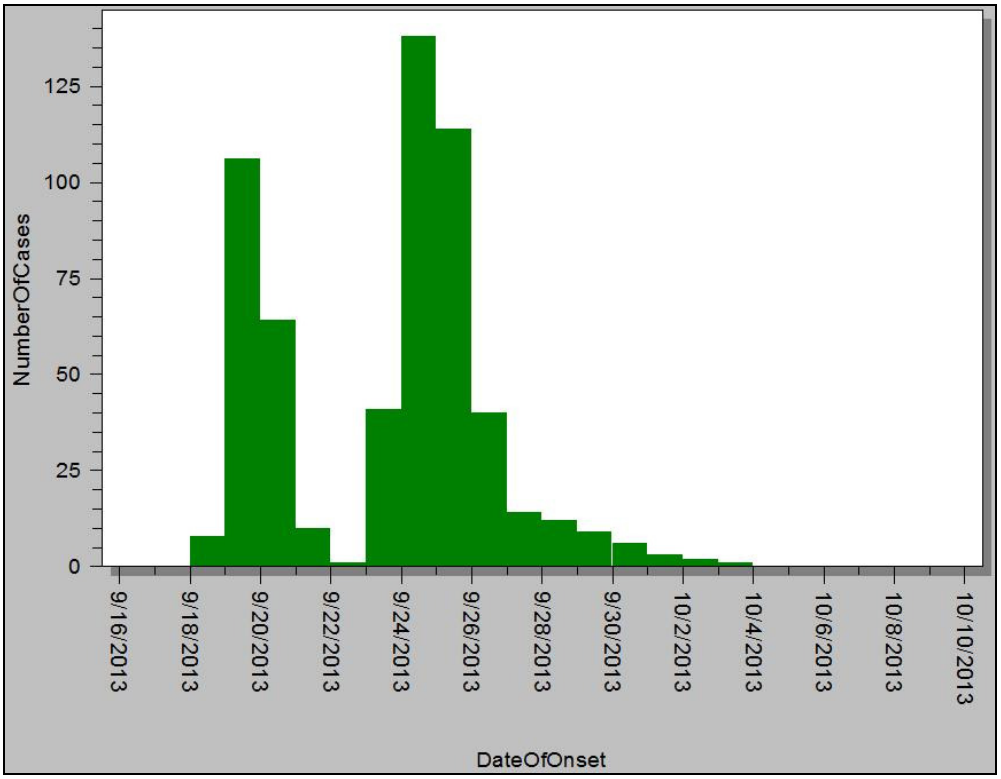


*Figure 2: Description of cases by time*

*3.5. Symptoms*

Symptoms of the suspected influenza are shown in fig 3

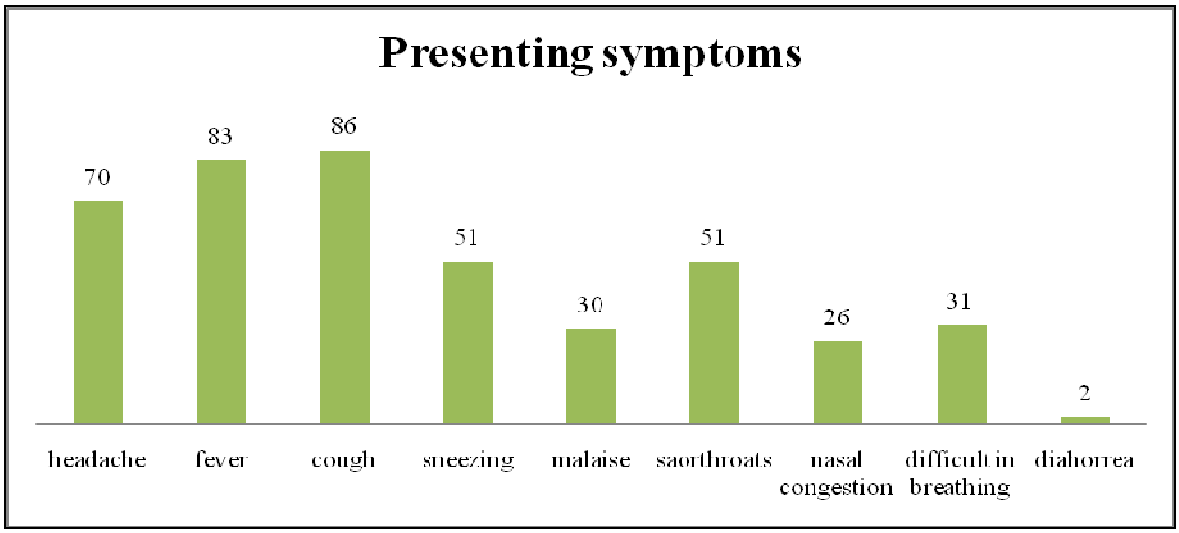


*Figure 3: Presentation of symptoms*

*3.6. Case Management*

Antibiotics were given to 76(79.9%) of all the cases, 41 (41.8%) received analgesics and 70(71.4%) of the cases had recovered. Antibiotics were given to patients with temperatures above 38 degrees Celsius

3.6.1. Risk Factors

| Factor | Cases | Controls | OR | 95% CI |
|---|---|---|---|---|
| Greeting by hugging and hand shaking Yes | 75 | 49 | 3.261 | 1.21 -10.19 |
| No | 23 | 49 | | |
| Place of residence | | | | |
| School | 19 | 5 | 4.473 | 1.17- 6.69 |
| Village | 79 | 93 | | |
| Having a visitor with flu symptoms in the past 7 days | | | | |
| Yes | 8 | 2 | 4.267 | 0.369-25.662 |
| No | 90 | 96 | | |
| | | | | |
| Sleeping in same room with flu patient in past 7 days Yes | 74 | 51 | 2.846 | 2.241-3.451 |
| No | 24 | 47 | | |
| Sharing clothes and bedding with a friend Yes | 16 | 8 | 2.16 | 1.29-7.456 |
| No | 83 | 90 | | |
| | | | | |
| Having a relative visiting in past 7 days Yes | 42 | 20 | 2.925 | 1.538-5.434 |
| No | 56 | 78 | | |

*Table 3: Factors independently associated with contracting influenza at Mukuvapasi and St Lukes Primary schools 2013*

Risk factors associated with contracting suspected influenza at Mukuvapasi and St Lukes primary school(Table 3) include: sleep with someone with flu symptoms in the past 7 days (OR=2.85: CI=2.24-3.45; p=0.008), having a relative visiting in past 7 days with symptoms of flu (OR=2.93; CI=1.53- 5.43; p=0.015), greeting by shaking hands or hugging any person who was ill within the last 7 days (OR=3.26; CI=1.21 - 10.19; p=0.001), sharing clothes and bedding with a friend(OR=2.16; CI=1.2812-7.4560; p=0.0091) and being a school resident (OR= 4.43; CI= 1.2145- 10.1904; p=0.015).However, having a visitor with flue like symptoms in past 7 days (OR=4.26; CI= 0.37- 25.66: p=0.18) was also a risk factor associated with contracting suspected influenza at the two schools but was not statistically significant.

*3.7. Stratified Analysis*

The association between greeting by shaking hands or hugging any person who was ill within the last 7 days and contracting suspected influenza was confounded by having visitors in the past 7 days for both cases and controls. Having visitors in the past 7 days overestimated the risk of developing suspected influenza in those who greet by shaking hands or hugging any person who was ill within the past 7 days. Having controlled for those who have visitors in the past 7 days, those who greet by shaking hands or hugging any person who was ill within the last 7 days were 2.86 times more likely to develop suspected influenza than those who did not. Furthermore the relationship between sharing clothes and bedding with friend and development of suspected influenza disease was modified by having sleep in the same room with someone with flu symptoms for both cases and controls. Those who developed suspected influenza were 1.18 times more likely had slept with someone with flu like symptoms than those who did not.

*3.8. Logistic Regression*

A logistic regression was conducted to determine the factors that remain statistically associated with developing suspected influenza A at St Lukes and Mukuvapasi primary school. Risk factors with a p-value ≤0.05 were fitted into the logistic regression model. Whilst controlling for having a visitor with flu like symptoms, the following factors remained independently associated with contracting suspected influenza disease at the two schools: greeting by hugging and shaking hands, sharing clothes and bedding with a friend, being a school resident, sleeping in the same room with a flu patient and having a relative visiting in the past 7 day. The following table 4 below illustrates this.

| Term | Odds Ratio | 95% | C.I. | Coefficient | S. E. | Z-Statistic | P-Value |
|---|---|---|---|---|---|---|---|
| Greeting by hugging | 3.2600 | 1.212 | 10.1932 | 1.1820 | 0.312 | 2.960 | 0.0001 |
| Sharing clothes and bedding with a friend | 2.1602 | 1.285 | 7.456 | 0.7701 | 0.310 | 2.430 | 0.0093 |
| Being a school resident | 4.473 | 1.717 | 6.69 | 1.4980 | 0.525 | 2.20 | 0.015 |
| Sleeping in same room with flu patient in past 7 days | 2.846 | 2.241 | 3.451 | 1.0459 | 0.310 | 2.42 | 0.008 |
| Having a relative visiting in past 7 days | 2.93 | 1.538 | 5.434 | 1.0733 | 0.323 | 2.41 | 0.0015 |
| **CONSTANT** | * | * | * | -2.2341 | 0.414 | -4.3127 | 0.0000 |

*Table 4: Factors independently associated with contracting suspected influenza at Mukuvapasi and St Lukes Primary schools*

*3.9. Response to the Outbreak*

A detailed spot map was displayed and line listing of cases indicating person, place and time. There were two nurses, one environmental health technician and one nurse aide at the clinic to care for both male and female patients and also carrying other routine duties at the health centre.

Both of the nurses were not trained in influenza case management. The environmental technician was overwhelmed since he covered two catchment areas for the two clinics which were Sangano and Nyahukwe clinics to carry out contact tracing, health education and active case finding in surrounding community. There were no rapid diagnostic test kits available at the clinic. There was no evidence that efforts were done to raise awareness both at the clinic at the affected schools as confirmed by 182 participants (92.9%) of all the participants interviewed showing very low level of awareness on what influenza is, predisposing factors, modes of transmission to other people, prevention and control measures. The district did not meet some of the following targets outlined in Table 5 for outbreak response to suspected influenza outbreak on most areas except for taking four laboratory specimens for culture which was in time.

| Activity | Target | Achieved |
|---|---|---|
| Time taken by the District to detect outbreak | 1 day | 2 day |
| Time taken by District to detect outbreak and notify PMD's Office | <24 hours | 48 hours |
| Period taken by district to take concrete response | <24 hours | 48 hours |
| Line list completed | Yes | NO |
| Laboratory specimens taken and outbreak confirmed | Yes | Yes |
| Time taken by the laboratory to process specimen and send results to district. | <48 hours | 24 hours |
| Period taken for the outbreak to be over. | 21 days | 23 days |

*Table 5: The District outbreak response according to integrated Disease surveillance and response in Zimbabwe*

*3.10. Environmental Assessment*

School class rooms were overcrowded for both schools because of change of teaching methods where teachers are required to teach their specialized subjects for the whole grade. The recommended standard area for class rooms as stipulated by the Education regulation (23 of 1976) is 68.4$m^2$ for 40 students. We measured floor areas of class rooms and divided by the number of students who were accommodated there and found that it was way below the standard recommended space, (one of the rooms was 60$m^2$ but it had 72 students and the other one had a floor area of 68.4$m^2$ yet it had 76 students).

*3.11. Control Measures*

School children who were ill were instructed not to attend schools so as to prevent spread of disease to others and health education was also done.

**4. Discussion**

Greeting by hugging an influenza patient in the previous 7 days was a significant risk factor for contracting suspected influenza at St Lukes and Mukuwapasi area. Greeting an influenza patient by hugging brings someone in close contact with patient's respiratory droplets thereby increasing the risk of infection. This is consistent with findings from a study done in Canada which showed that human contact in churches, hospitals and community were implicated in influenza A H1N1 transmission (MMWR; Nicholls 2008). The WHO report of September 2009 also indicated that, schools are amplifying transmission of the pandemic virus, both within schools and into the wider community. While outbreaks in schools are an important dimension of the current pandemic, no single measure can stop or limit transmission in schools, which provide multiple opportunities for spread of the virus (Thompson, Shay and Weintraub, 2004).

According to a study done in England transmission in schools is fuelled by higher attack rates among children. This may reflect their increased susceptibility to infection and opportunities for congregation and spread within the school environment. During the 2005/06 influenza season, the overall attack rate in schools in England and Wales was 24.1% with a range of 14.6% to 44.9% across different regions (Zhao, 2007). Pandemic (H1N1) 2009 influenza has been notable for explosive outbreaks in school settings. During an outbreak in New York City, USA, 33% of students reported influenza-like symptoms (Frieden, 2009).

Sleeping in the same room with someone with suspected influenza in the previous 7 days was also significantly associated with contracting influenza. Sleeping in the same room with suspected influenza patient also predisposes one to patient's respiratory droplets for long periods, thereby increasing risk of getting infected.

Sleeping in the same room, sharing clothes and bedding with friends are described as close contact by the Centres for Disease Control and prevention (CDC) in their interim guidelines of October 2009 where it was cited that *close contact* is defined as having cared for or lived with a person who is a confirmed, probable, or suspected case of influenza, or having been in a setting where there was a high likelihood of contact with respiratory droplets and/or body fluids of such a person. Examples of close contact include sharing eating or drinking utensils, physical examination, or any other contact between persons likely to result in exposure to respiratory droplets.

On case management, the health facility had inadequate staff to cater for an influx of cases during the initial stages of the outbreak. There was only one nurse during the day and one nurse during the night to manage an average of 90 patients per day. Health staff lacked skills in managing influenza cases. This was compounded by lack of protective clothing for proper infection control measures. There were no environmental health technicians to do follow-up of patients treated as outpatients and contact tracing. There were no influenza treatment guidelines at the health facility and this resulted in indiscriminate use of antibiotics.

The district health executive did not have EPR plans for suspected influenza. This impacted on the district's ability to detect and institute concrete measures on time as evidenced by time taken by district to report the index case to the Provincial Medical Director's office (48hours instead of 24 hours). The district did not meet its targets for response to suspect influenza on most areas except on time taken to detect the outbreak, having the line list and taking laboratory specimens to confirm the diagnosis. This is consistent with a study by Ortu et al. (2008) on Pandemic influenza preparedness in Africa a profound challenge for an already distressed region: analysis of national preparedness plans found out that thirty-five (67%) plans available from 53 African countries. Thirty-three plans address human surveillance and among these plans, only one plan indicates a monitoring of seasonal influenza, eight harness sentinel surveillance, nine address acute respiratory infections, and eight mention the surveillance of influenza-like illnesses. In terms of diagnostic capacity, 16 plans refer to a laboratory offering routine diagnostic services for influenza, but only eight mention a reference laboratory that will receive human specimens for virus detection. All plans do not specify what type of tests are offered by institutions, and only one plan refers to a WHO accredited laboratory. Control measures such as isolation of cases and contact tracing were not done resulting in the increase in spread of the disease. Health staff concentrated on the primary schools identified and those who reported at the clinic.

*4.1. Recommendations*

The district Environmental health officer should recall other environmental health technicians from other wards to assist in contact tracing and health education sessions in the future. Health Promotion officer and nurses must give health education to school children and community to avoid close contact during outbreaks. Similarly, headmaster(s) should educate school children and teachers to avoid overcrowding in class and to avoid being in close contact with other children who are still in the infectious stage. The District Medical Officer(s) must train health staff on management of influenza to ensure appropriate use of treatment protocols and available resources and also coordinate formulation and implementation of EPR plans for influenza in their respective districts.

**5. Conclusion**

The study revealed that risk factors associated with contracting suspected influenza include: Greeting a suspected influenza patient by hugging and shaking hands in the past 7 days, Sleeping in the same room with flu patient in past 7 days, sharing bedding with a suspected influenza patient, overcrowding on a small bench in classrooms with others who were infected and having a relative visiting in the past 7 days with suspected influenza. Health staff did not have skills to manage suspected Influenza and there were no treatment guidelines, no resources and the health facility was short staffed. The district did not have Epidemic preparedness and Response plan

(EPR) in place to control suspected influenza and there was lack of knowledge among school children and community members on mode of spread of influenza and development of immunity. Strengthening and reviewing EPR plans collectively with all stakeholders will go a long way in curbing future outbreaks and their impact on affected communities.

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