Factors associated with watery diarrhoea diseases in under-five children in Chakari Mine of Sanyati District in Mashonaland West, Zimbabwe .September 2011.

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Abstract

Introduction: Globally, there are about 3.2 million deaths worldwide in children under 5 years from diarrhoea every year (WHO, 2010). Child mortality and morbidity mostly results from contaminated food and water sources. Reported attack rates in developing countries range from 1 to 12 episodes per child per year. Kadoma District before it was split once experienced outbreak of diarrhoea in 2007 where 34 children under five years died. Chakari mine area experienced an increase of watery diarrhoea cases since week 26 from 6% to 17% by week 39 of September 2011. The increase was noticed on the 6th of September 2011 of which 74% of the cases were Children under the age of 5 years presenting with watery diarrhoea, fever and some with vomiting. We set out to describe the outbreak and identify risk factors and institute prevention and control measures. **Methodology**: An unmatched 1:1 case control was carried out. **A case** was any child under five years of age who presented with diarrhoea, with or without vomiting and other symptoms from the 6th of September 2011 and has been resident in Chakari mine for two weeks prior to onset of the symptoms. A diarrhoea case was defined as having passed three or more loose stools within 24 hours. Controls were any child who did not develop diarrhoea from the 6th of September up to the day of the interview, and has been a resident neighbour of Chakari mine for the previous two weeks. An interviewer administered questionnaire was used for data collection. Checklist for resources was used. Multivariate analysis for risk factors was done using EPI INFO V 3.5.3 statistical package. **Results:** A total of (76) case caregivers and (76) control caregivers were interviewed. Cold Sadza and cold porridge were statistically significant risk factors which were associated with contracting watery diarrhoea with Odds Ratio [13(95%CI 2.3, 71.7) p=0.00034] and [OR, 28.7(95% CI 2.2, 362.7)p=0.0096] respectively. Cold vegetables were protective from contracting diarrhoea with Odds Ratio [0.1(95% CI 0.01, 0.96) p=0.05]. Washing of hands in one bowl at home was the only independent risk factor which was statistically significant associated with contracting diarrhoea in Chakari mine at adjusted Odds Ratio [11.4(95% CI 1.86,70.1) p=0.008]. D**iscussion and Conclusion**: Cold Sadza and cold porridge was the major risk factors associated with contracting watery diarrhoea in Chakari. The major finding indicated that the food was being contaminated by the practice of washing hands using the same bowl. The caregivers need health education on the importance of hand washing before eating using the run to waste method. The water for Chakari mine needs Chlorination to improve its quality.

Keywords: Case-control, watery diarrhoea, outbreak investigation

Introduction

Diarrhoea is defined as the passage of three or more loose stools or liquid stools per day. It is usually a symptom of an infection in the intestinal tract which can be caused by a variety of bacterial, viral and parasitic organisms. Diarrhoea is associated with ¼ of all deaths in children under 5 years in developing countries(1).Although oral rehydration has been shown to reduce early child mortality, the diarrhoea-specific mortality in children less than 5 years of age in Africa has been estimated at about 10.6 per 1000(2).

Causes of diarrhoea in areas of endemicity include a wide variety of bacteria, virus and protozoa. Poor food hygiene, water and sanitation are common in communities with high levels of diarrhoeal diseases .Underlying conditions such as malnutrition which modify the risk of contracting diarrhoea are also common in sub-Sahara Africa of which epidemics are common in these areas.

Mashonaland west province has been experiencing diarrhoea outbreaks as on 18th June 2007 Kadoma District before it was split into two Sanyati and Mhondoro Ngezi District had an outbreak where 34 children under 5 years died. The aetiology of the diarrhoea was characterised by fever, acute watery diarrhoea, vomiting and dehydration. The report indicated that the prognosis was very poor in children reporting late for treatment with severe dehydration and other conditions.

During the 2007 outbreak the laboratory isolated E.Coli, Shigella, Shigella flexineri, Shigella boydii which was sensitive to gentamicin or kanamicin. Stool Specimen taken by WHO to virology laboratory isolated Rotavirus.

Chakari mine area is a gold mine which is located in the North, 41 km from the Kadoma Hospital where there is the Sanyati District health team. The mine residence is composed of

the mine workers who were recently engaged with a new Dalnly mine company which has started to operate the mine. Most of the residence they rely on gold panning and Vending. The catchment area has a total population of 24 683 and those under the age of 5 years are 3 394.

Chakari mine has experienced an increase of watery diarrhoea cases since week 26 from 6% to 17% in week 39 of year 2011. The increase of cases started on the 6th of September 2011 of which 74% of the cases were under 5 years presenting with watery diarrhoea, fever and some with vomiting, the following diarrhoea thresholds were calculated.

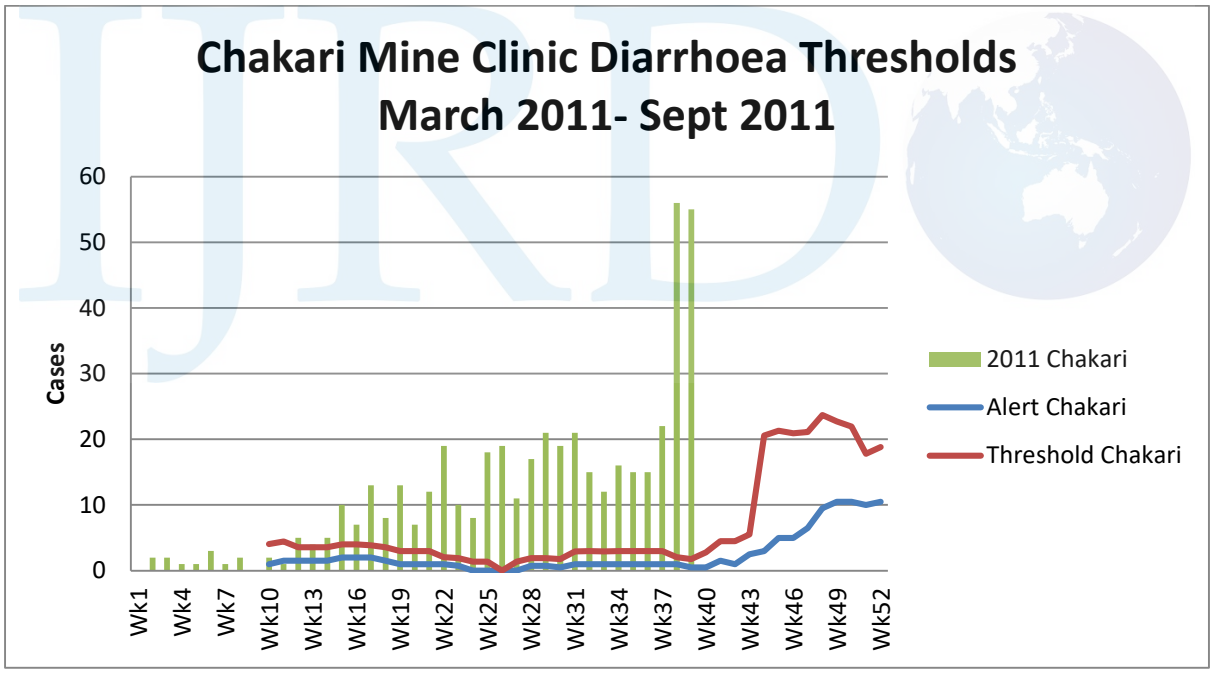

Figure 1: Chakari Mine Clinic Thresholds for Diarrhoea (Dist. Health Information Profile 2011)

Fig 1: Above shows that the outbreak started in week 12 when the diarrhoea thresholds were surpassed unnoticed as there were no calculated diarrhoea thresholds even for the whole Sanyati District .The cases have been increasing and in week 39, 55 cases of diarrhoea were reported, cumulatively a total of 468 cases have been reported from the 6th September 20011.

The nurse in- charge realized the outbreak when in week 37 due to unusual increase of diarrhoea in the catchment area of Chakari mine Clinic. Attack rate of diarrhoea was at 190 per 10 000 population.

The purpose of the study was to describe the outbreak in terms of person ,Place and time, to identify the risk factors that were associated with contracting watery diarrhoea and assess the knowledge and practices of the under 5 years caregivers of Chakari Mine with regard to Diarrhoea. The study was also to evaluate the timeliness and quality of outbreak detection, investigation and response. The study also sought to determine the factors associated with the watery diarrhoea outbreak in Chakari Mine of Sanyati District, 2011.

METHODOLOGY

3.1 Research Design

We conducted an unmatched Case-Control study in children less than five years in Chakari Mine. Cases were children under five years of age who presented with diarrhoea, with or without vomiting and other symptoms and resident at Chakari Mine for two weeks prior to onset of the symptoms. A diarrheal case was defined as having passed three or more loose stools within 24 hours. Controls were **children** who did not develop diarrhoea in the months before the interview date, and had been resident in or near Chakari Mine for the previous two weeks.

Sampling

The sample size was determined using using STATCAL EPI INFO package, assuming 52.23 % exposure in controls and 76.02% exposure in cases, to high rates of enteropathogen isolates in stool samples from children without diarrhoea, Shigella species had Odds Ratio of 2.90, 95% confidence level, 80% power, and 10% refusal rate, sample was to be 78 cases and 78 controls. This study managed to sample 76 cases and 76 controls. Included in the study were children under five years of age who had had diarrhoea for less than 2 weeks. We

excluded children who had had diarrhoea for 2 weeks or more. On the other hand, children who had not given assent to study or whose caregivers had not given voluntary signed consent were excluded from the study. Cases were randomly selected using random numbers and the outbreak line list as the sampling frame. Prospective cases that declined to participate were replaced. For controls, we conveniently sample from neighbour houses away from the home of the case. If there was more than one child under five years at the household, we select a child whose age was closest to the age of the case.

Data Collection Technique and Tools

A Structured Interviewer administered Questionnaires was used for caregivers of cases and controls. We collected information on the demographics attributes of the case or control, and that of the caregiver. We administered an interview whose interview schedule probed into clinical presentation, caregiver`s knowledge of diarrhoea, water, food handling in household, environmental information. We also used a checklist to assess resource availability outbreak response, from the first time cases occurred in the community, until the time the outbreak audit is done. The checklist was adopted from the IDSR guidelines (WHO, 2010).

3.7 Reliability and Validity

The questionnaire was examined for content validity by clinical experts and academic supervisors. It was then pretested on 5 caregivers who were randomly selected from the line list and 5 controls from either the household or neighbourhood. The checklist for the evaluation of the outbreak response was adopted from the Integrated Disease Surveillance response Module 7. Data was analysed for means, proportions, frequencies, measures of association (odds ratios) and CI (95%) using EPI INFO version 3.5.3. Stratified analysis and logistic regression was also done using the same statistical package. Statistical analysis was done to check for effect modification and confounding.

Ethical Considerations

The study followed the Nuremberg code. Permission to conduct the study was sought from the District Medical Officer, Chakari Mine Management and the Provincial Medical Director of Mashonaland West. Assent and written informed consent were obtained from all study participants and caregivers, respectively.

RESULTS

4.1.1 Description of the outbreak by person

A total of 322 cases of watery diarrhoea were line listed at Chakari Mine clinic as from 5th to the 20th October 2011. The total population of Chakari is 24 414 according to DHS (2008) and the attack rate was 132 persons per 10 000 population. The majority of the cases 95 (49%) were under five years as indicated in the **Fig: 2** below:

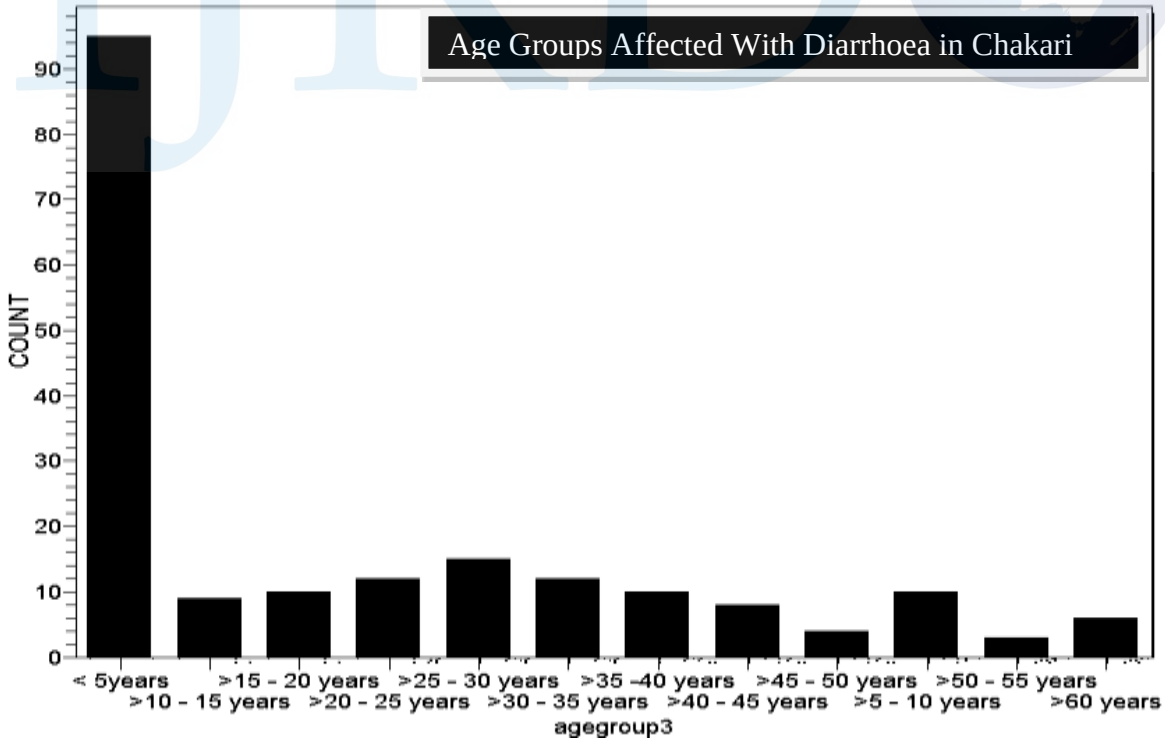

Figure 2: Age group affected with diarrhoea in Chakari Mine

The mostly affected age group in under five were below the age of 2years (24 months) as indicated in **Fig: 3** below:

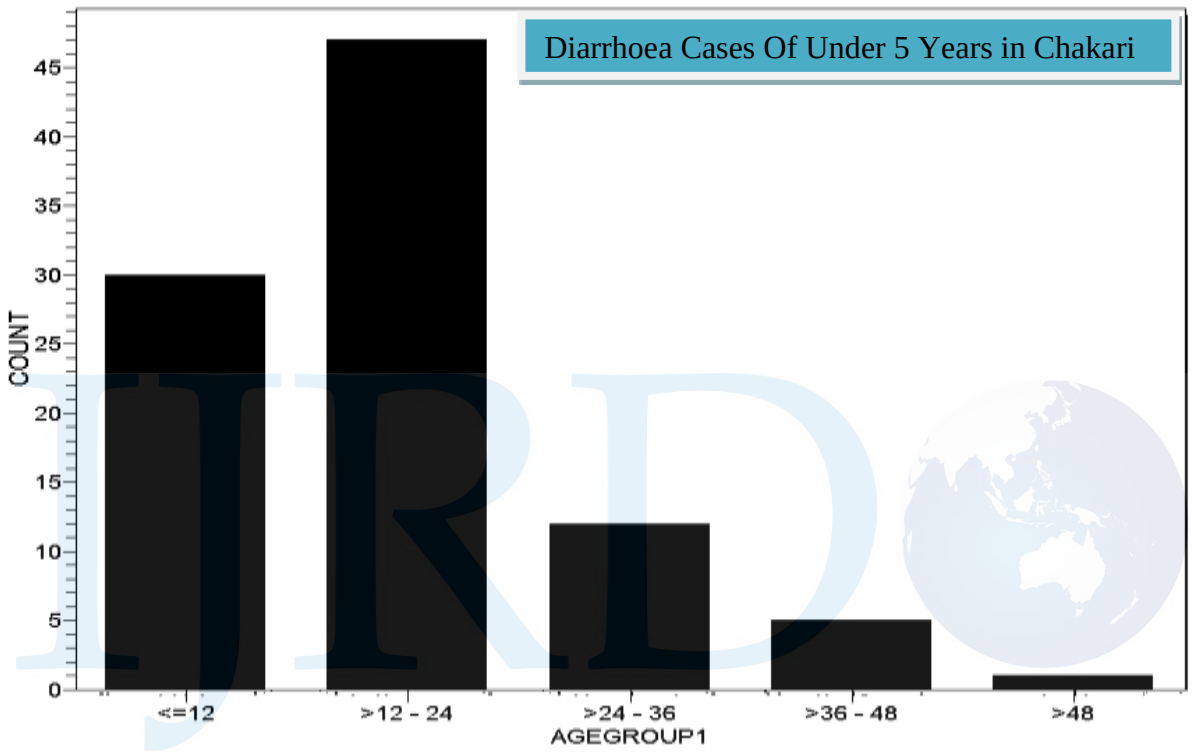

Figure 3: Diarrhoea Cases of under 5 years in Chakari Mine

The mostly affected under five Children by Gender were males 50(52%) and females 45(47.4%) and their median age was 17 months (Q1=11, Q3=24).

The objective of the outbreak investigation was to recruit 78 cases and 78 controls. The cases were recruited from the 95 under five years who presented to the clinic between 5 September to 04 October 2011 with a history of watery diarrhoea, vomiting and fever.

A total of 152 care givers were interviewed 76(cases) and 76(controls) the median age of care givers was 26 years (Q1=22:Q3=30.5) cases and 26.5years (Q1=23:Q3=31) controls. The median age of the under fives respondents were 21.5 months (Q1=14:Q3=36) cases and

26 months (Q1=15:Q3=38) controls.

Table 1: Demographic Characteristics of Study Respondents in Chakari Mine

Variable	Cases N=76(%)	Controls N=76(%)
Median Age of caregivers	26 years(Q1=22:Q3=30.5)	26.5years(Q1=23:Q3=31)
Demographic Characteristics of Under five		
Median Age Under Fives	21.5 months (Q1=14:Q3=36)	26 months (Q1=15:Q3=38)
Sex		
Male	43(56.6)	36(47.4)
Female	33(43.4)	40(52.6)

The age groups of the under five years were as follows:

Table 2: Age Groups of the Under Five years

Variable	Cases N=76 (%)	Controls N=76(%)
AGE GROUP		
< 12 months	14(18.4)	13(17.1)
>12 -24 months	33(43.4)	24(31.6)
>24-36 months	14(18.4)	20(26.3)
>36-48 months	8(10.5)	13(17.1)
>48-60 months	7(9.2)	6(7.9)

4.1.2 Socio-Demographic Characteristics of Cases and Controls

Most of the caregiver respondents of cases were mothers 69(90.8%) and on controls were 72(94.7%). The level of education of the cases and controls was very high with 54(71.1%) of the cases and 50(65.8%) of the controls had attained a secondary level of education compared to 20(26.3%) cases and 25(32.9%) of controls having attained primary level.

The most dominant religion was orthodox 27(35.5%) among cases and 23(30.3%) among controls. Those belonged to Apostolic faith sect were 19(25%) from the cases and 25(32.9%) were controls. On the employment status 34(44.7%) of the cases were not employed as well as 51% of the controls. Thirty three (43.4%) were house wives of the cases as compared to 35(46.1%) of the controls. The median house hold size was the same 5(Q1=4:Q3=7) for cases and 5(Q1=4:Q3=6) for the controls. The Table 3 shows the Univariate analysis of the demographic characteristics of the cases and the controls.

Table 3: Socio-Demographic Characteristic of Caregiver Respondents of the Cases and Controls in Chakari Mine

Variable	Cases N=76(%)	Controls N=76(%)
Caregiver Status		
Aunt	1(1.3)	0(0)
Grand Mother	5(6.6)	4(5.3)
Maid	1(1.3)	0(0)
Mother	69(90.8)	72(94.7)
Educational Level		
None	1(1.3)	1(1.3)
Primary	20(26.3)	25(32.9)
Secondary	54(71.1)	50(65.8)
Tertiary	1(1.3)	0(0)
Religion		
Apostolic Faith Sects	19(25)	25(32.9)
Orthodox	27(35.5)	23(30.3)
Pentecostal	22(28.9)	19(25)
Traditional	8(10.5)	9(11.8)
Employment Status		
Formally Employed	2(2.8)	2(2.8)
Informally Employed	7(9.1)	0(0)
Housewife	33(43.4)	35(46.1)
Not Employed	34(44.7)	39(51.3)
Median Household Size	5(Q1=4:Q3=7)	5(Q1=4:Q3=6)

4.2 Description of the Outbreak by Place

Most of the cases in the watery diarrhoea outbreak in Chakari mine were coming from M4 residential area of which 18% of the total cases were recorded. The second affected area was the Tafara residential area where also 15% of the cases were recorded. The E and D residential area recorded almost the same cases which were (8%) and (7.7%) respectively. The M1 and Tarkois had both (5.7%) cases.

The **Fig: 4** below indicates the distribution of cases by place of residence of the Chakari Mine Compounds.

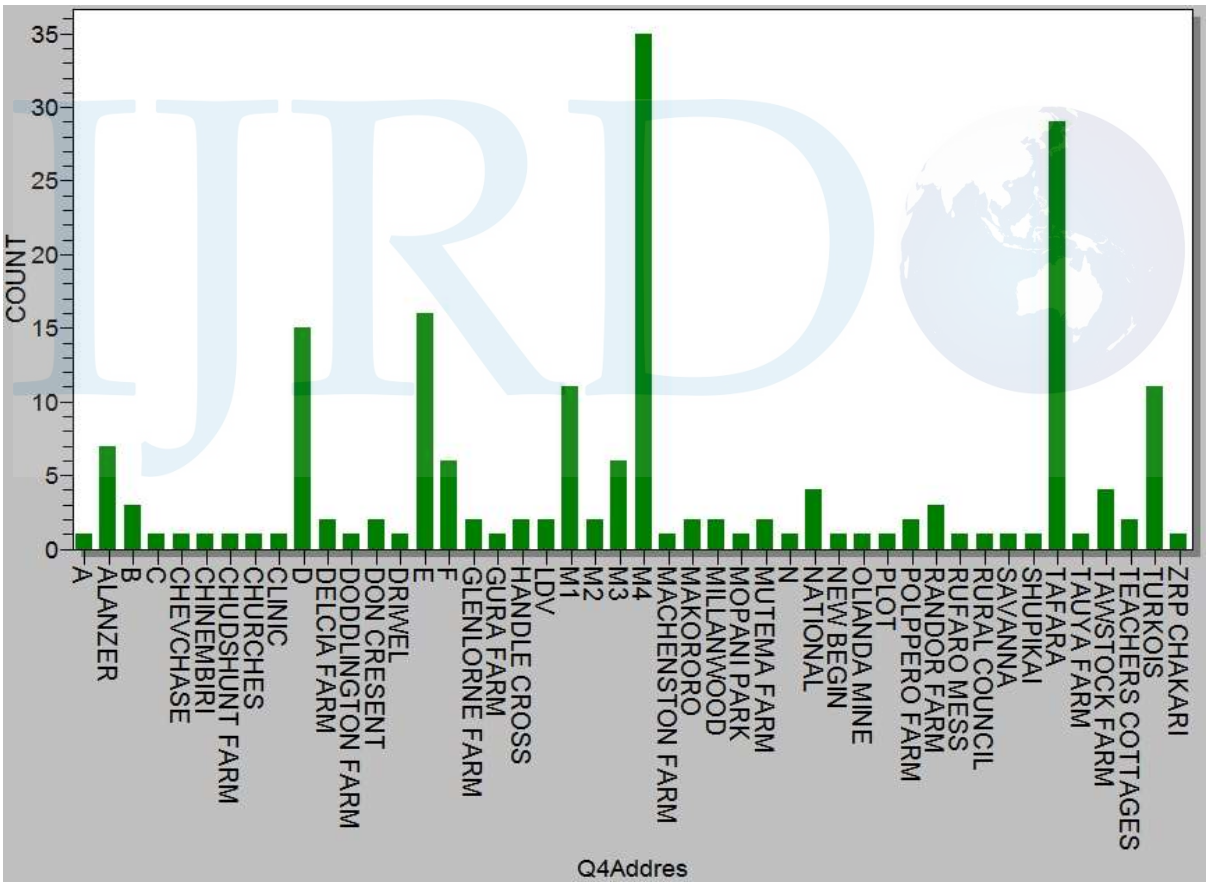

Figure 4: Distribution of Cases by Place of Residence of Chakari Mine Compound

4.3 Description of the Outbreak by Time

The description of the Diarrhoea outbreak in Chakari Mine as indicated by the Epidemiological Curve **FIG 6:** below was characterised by multiple peaks which were noted from 3rd of September to 8th September 2011 with initially small peaks and increasing gradually, another peak from 10th to the 12th September 2011 of which the number of cases had increased significantly thus when the Nurse in Charge realised that they were in a diarrhoea outbreak. The third peak was on the 18th to the 24th September 2011. The highest peak was on the 25th of September to 30th of September 2011. The total multi-peaks to 20th October 2011 mounted to seven. The Epi-Curve shows an interval of an incubation periods of 3-5 days apart this indicates that it was a propagated outbreak which is generally associated with water washed mode of transmission where people were being exposed to causative agent at different times.

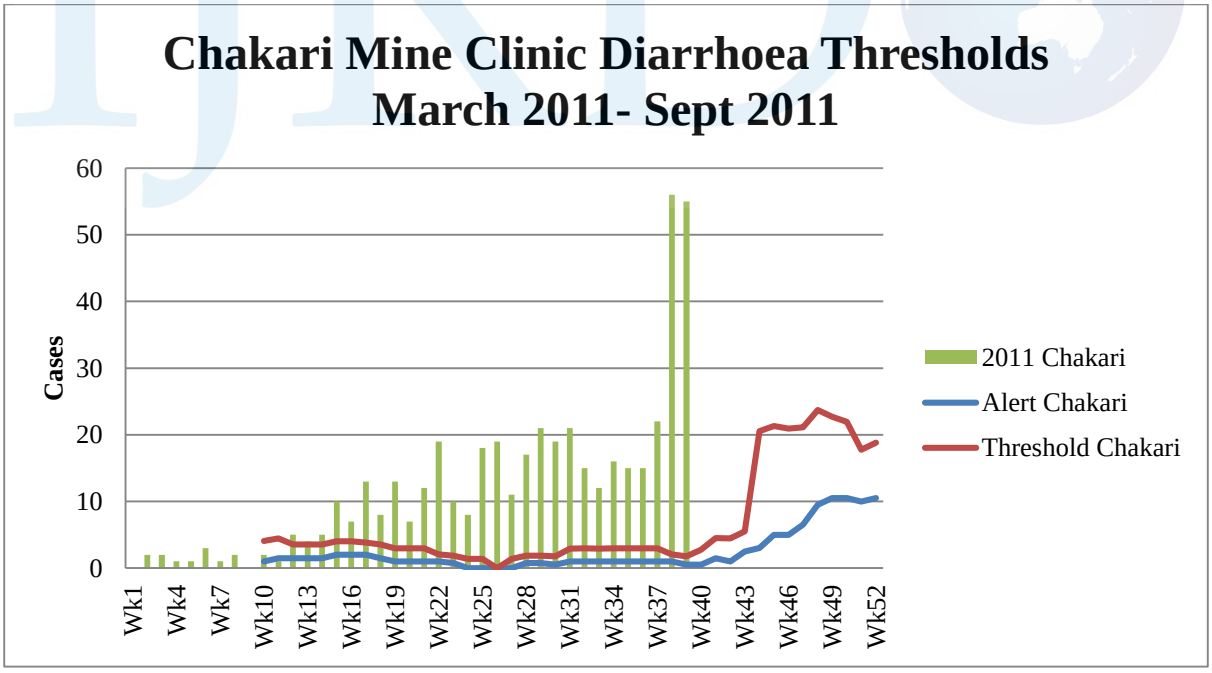

Figure 5: Chakari Mine Clinic Diarrhoea Thresholds March 2011-December 2011

The **FIG 5** above shows diarrhoea action threshold for Chakari Mine Clinic was crossed in week 12 which was in March 2011 and was not noticed and it was self limiting. The outbreak

was detected on the 12th of September 2011, week 37 and notified to the District when they had an increased number of cases in one week which were 25 cases.

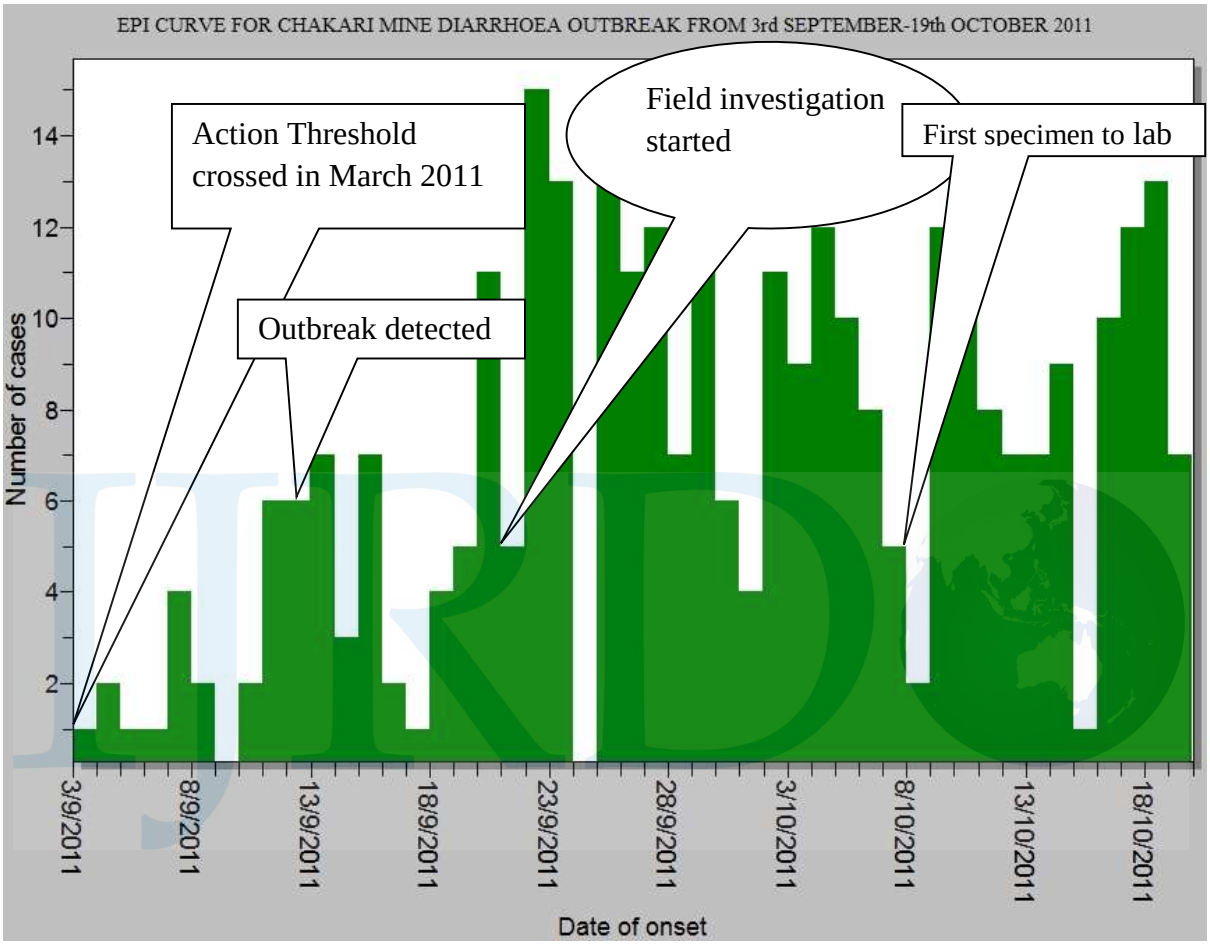

Figure 6: EPI Curve for Chakari Mine Diarrhoea Outbreak September-October 2011

4.4 Clinical Presentation and treatment Management of Diarrhoea Outbreak

The most cases in Chakari mine clinic presented with watery diarrhoea 86%, bloody diarrhoea 7% and mucous diarrhoea 10%, vomiting was 12% and only 1% presented with fever as indicated in **FIG 7:** below.

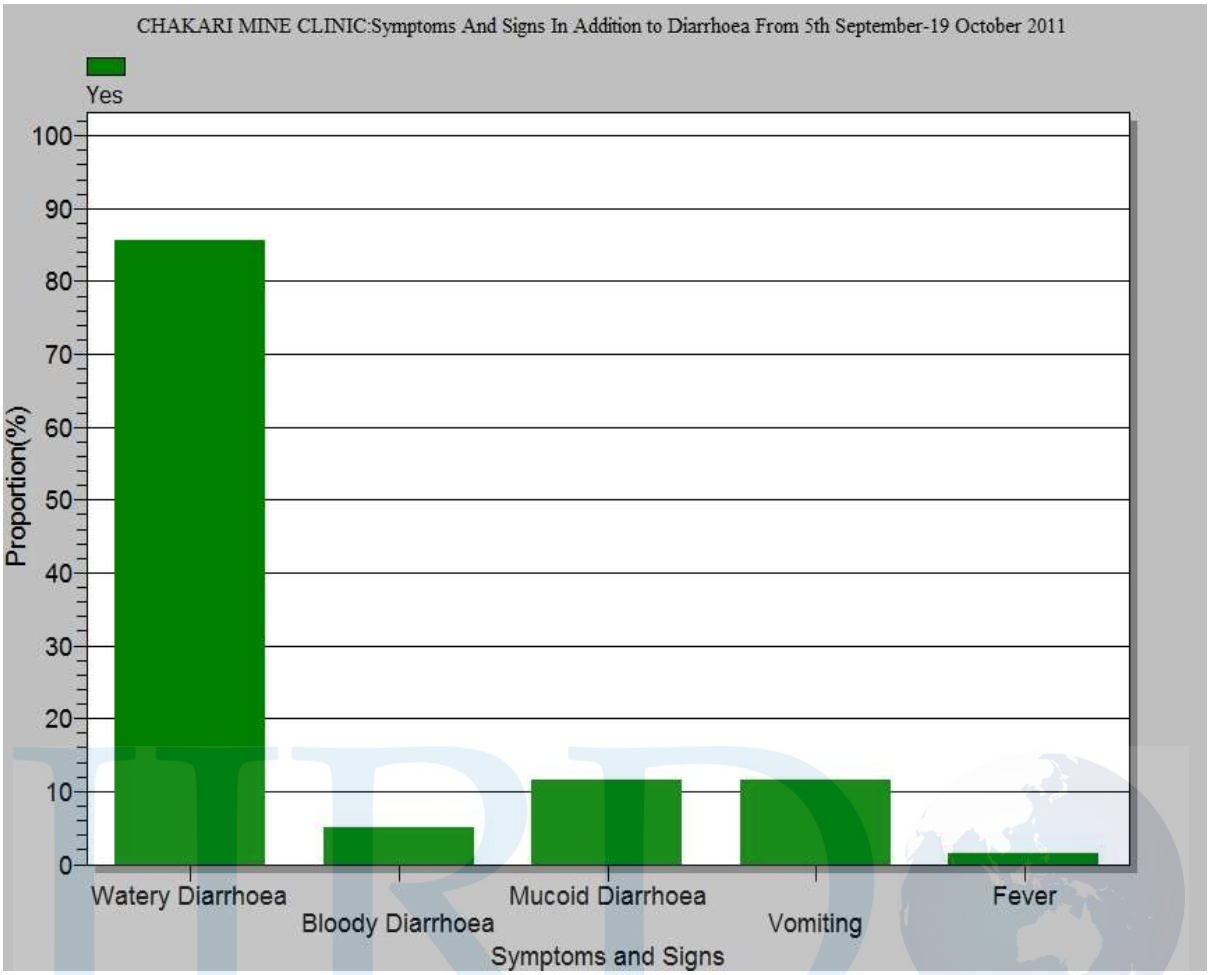

Figure 7: Symptoms and Signs during the Outbreak

Under 5 year cases (90%) presented with watery diarrhoea, bloody diarrhoea 11% and 1% with mucous diarrhoea.

On the treatment of diarrhoeal cases of all ages 95% were given ORS, 48% were given Cotrimoxazole, 25% Zinc Sulphate, 4% doxycycline and 2% nalidixic acid and metronidazole and 3% promethazine. The under five children were given 46% Cotrimoxazole, 41% Zinc Sulphate and 95% ORS. On the status of the cases and the controls of children included in the study the immunisation against childhood diseases including measles for the 69(98.6%) of cases and 67(97.1%) of controls were up to date. There were 12(17.6%) of the cases and only 4(5.8%) of the controls were malnourished while 56(82.4%) of the cases and 65(94.2%) of the controls were well nourished.

Among the cases 23(31.5%) reported that there was someone suffered from vomiting and diarrhoea 5 days prior to illness of child. The case caregivers 48(64.8%) reported that oral rehydration treatment was given at home before reporting to Chakari clinic for those who did not give ORS, 8(40%) forgot to give the child ORS and 9(45%) had missing ingredients to prepare as 49(64.5%) had sugar and 60(78.9%) had only salt. The majority of the cases of diarrhoea 65(94.2%) indicated that they were satisfied with the treatment given at the clinic.

4.5 Laboratory Results

Stool samples were collected on the 7th of October 2011. The 2 samples one was watery diarrhoea and the other mucoid. The results isolated Shigella and were sensitive to clindamycin and streptomycin.

Water samples collected in Chakari Mine the results were unsatisfactory as they were have coliforms above the accepted standards for water fit for human consumption as it is suppose to have a zero trace of the coliforms. This indicates that the water was not safe especially in M4 residence where the majority of cases were recorded. **FIG 8** below indicates the results:

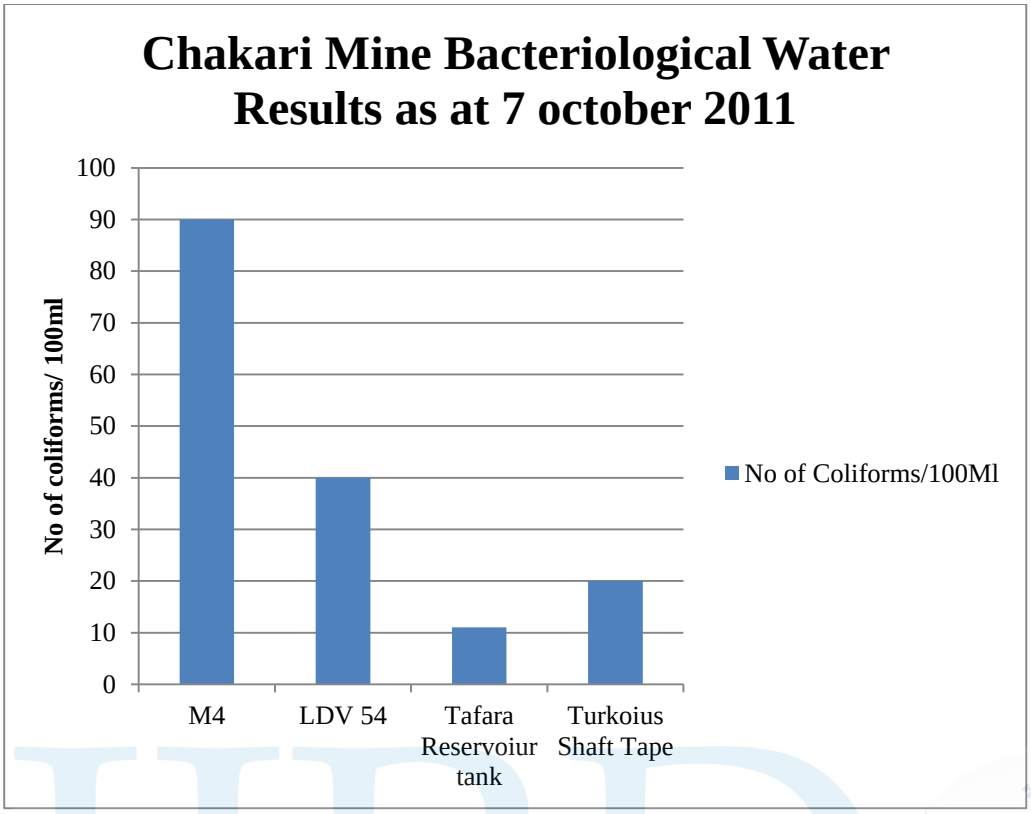

Figure 8: Chakari Mine Bacteriological Water Results as at 7 October 2011

4.6 Analysis of Risk factors

On Bivariate analysis the giving and eating child of most cold foods was a risk factor of contracting diarrhoea in under 5 years in Chakari mine as it was statistically associated with Diarrhoea. The eating of cold Sadza had an Odds ratio [OR, 8.3(95%CI 3,23) p=0.00002] cold porridge [OR,21.6(95%CI 2.8,167)p=0.00003], Cold vegetables [OR,4.4(95%CI 1.54,12.6)p=0.06], cold salad [OR,11.4(95%CI 1.4,91)p=0.01], cold rice [OR,3.5(95%CI1.39,8.92)p=0.01] and cold beans[OR,8.4(1.83,38.18)p=0.001].

Being employed of the caregiver was also associated with cases of diarrhoea as compared to the controls at Odds Ratio [5(95%CI 1.04, 23.8) p=0.03].Those children who were undernourished were more likely to have diarrhoea than those not undernourished [OR, 3.5(95% CI 1.06, 11.4) p=0.03). The caregiver of cases who were knowledgeable about

diarrhoea were more likely to have diarrhoea as compared controls with Odds Ratio [5.4(95%CI 1.7, 16.7) p=0.001].

Children who were being bottle fed were 3.1 times more likely to have suffered from diarrhoea than those not exposed to bottle feeding(controls) although it was not statistically significant [OR,3.1(95% CI 0.3,30.8)p=0.30]. washing of hands in one bowl was also statistically associated with cases of Diarrhoea as those who used one bowl to wash their hands were 5.6 times more likely at risk of suffering from diarrhoea(cases) as compared to controls [OR,5.6(95%CI 1.4,21.9) p=0.02).

The presence of flies at home was also associated with episodes of diarrhoea among cases [OR, 5.3(95% CI 2, 13.9) p=0.0006] as compared to controls. The presents of a dump site near family home was also associated with diarrhoea (cases) Odds Ratio 4.5(95% CI 2.1, 9.7) p=0.0001.

The source of water used by families more than five families were also associated with cases of diarrhoea X^2 =5.85 1df p=0.05.

The factors which were associated with reduced likelihood of contracting diarrhoea were a child being breast fed [OR, 0.55(95% CI 0.26, 1.44) p=0.1) and being educated [OR, 0.7(95% CI 0.4, 1.5) p=0.85]. These factors were not statistically significant at 5%.

The Risk factors are summarised in the **Table 4**: below:

Table 4: Factors associated with contracting Diarrhoea in Chakari Mine of Sanyati District: Bivariate Risk Factors.

Variables		Cases N=76 (%)	Controls N=76 (%)	OR (95% CI)	p-Value
Cold Sadza	Yes	28(36.8)	5(6.6)	**8.3(3,23)**	0.00002*
	No	48	71		
Cold Porridge	Yes	17(22.4)	1(1.3)	**21.6(2.8,167)**	0.00003*
	No	59	75		
Cold Vegetable	Yes	18(23.7)	5(6.6)	**4.4(1.54,12.6)**	0.006*
	No	58	71		
Cold Salad	Yes	10(13.2)	1(1.3)	**11.4(1.4,91)**	0.01*
	No	66	75		
Cold Rice	Yes	20(26.3)	7(9.2)	**3.5(1.39,8.92)**	0.01*
	No	56	69		
Cold Beans	Yes	14(18.4)	2(2.6)	**8.4(1.83,38.18)**	0.001*
	No	62	74		
Employed	Yes	9(11.8)	2(2.6)	**5.0(1.04,23.8)**	0.03*
	No	67	74		
Under Nourished	Yes	12(17.6)	4(5.8)	**3.5(1.06,11.4)**	0.03*
	No	56	65		
No education/Primary		21(27.7)	26(34.2)	0.7(0.4,1,5)	0.48
Secondary/Tertiary		55	50		
Child bottle fed	Yes	3(4.2)	1(1.4)	3.1(0.3,30.8)	0.3
	No	69	72		

Wash hands in	Yes	8(50)	5(15.2)	**5.6(1.4,21.9)**	0.02*
One bowl	No	8	28		
Flies in home	Yes	69(92)	52(68.4)	**5.3(2,13.9)**	0.0006*
	No	6	24		
Dumpsite near	Yes	60(83.3)	40(52.6)	**4.5(2.1,9.7)**	0.0001*
Home	No	12	36		

Statistically Significant

4.7 Multivariate Analysis

The food variables those were significantly associated with water diarrhoea at 95% confidence interval in the above **Table 4** formed our first Logistic regression model. The eating of Sadza [AOR, 13(95%CI 2.2, 71.7) p=0.003] and porridge [AOR, 28.7(95%CI 2.26, 362.8) p=0.01] both were Independent risk factors of while eating of cold vegetables [AOR, 0.10 (95%CI 0.01; 0.9) p=0.05] was an independent protective factor at 95% confidence interval. The following **Table 5** shows the results:

Table 5: Multivariate Analysis of Cold Foods Results

LOGISTIC CaseLR2 = Sadza ,Porridge, Vegetables
Unconditional Logistic Regression

Term	Odds Ratio	95%	C.I.	Coefficient	S. E.	Z-Statistic	P-Value
Sadza (Yes/No)	12.9547	2.3395	71.7353	2.5615	0.8732	2.9333	0.0034
Porridge (Yes/No)	28.6621	2.2647	362.7559	3.3556	1.295	2.5912	0.0096
Vegetables (Yes/No)	0.106	0.0116	0.9665	-2.2442	1.1276	-1.9902	0.0466
CONSTANT	*	*	*	-0.4283	0.19	-2.254	0.0242

After including the washing of hands in one bowl at home into our Logistic Model only the washing of hands in one bowl was independently associated with watery diarrhoea in Chakari [AOR11.4(95%CI 1.86,70.1) p=0.008. This major finding indicates that the food which was the major risk factor was being contaminated by the practice of washing hands using the same bowl.

4.8 Knowledge levels of Diarrhoea Caregiver Cases and Controls in Chakari Mine.

The caregivers 69(94%) of the cases and 58(76.3%) of the controls were knowledgeable on the definition of diarrhoea. On the mode of spread of watery diarrhoea drinking contaminated water was mentioned by 63(82.2%) of the case caregivers and 64(84%) of the controls. Eating contaminated food was mentioned by 63(82.9%) of cases as compared to 66(86.8%) of the controls. Among case caregivers 13(17.1%) did not mention eating contaminated food only 6(7.9%) among case caregivers and 6 (7.9%) of controls indicated that someone can contract diarrhoea from the air.

4.8.1 Knowledge of Caregivers on diarrhoea Management

Among the case care givers 71(93.4%) they indicated that they give salt and sugar solution to diarrhoea children and among the controls it was mentioned by 69(90.8%). Two (2.6%) among case caregivers mentioned giving antibiotics first to diarrhoea children and also the same number by control caregivers. Thirty two (42.1%) of cases and 34(44.7%) of controls indicated that they will visit the clinic first before giving salt and sugar solution. This may contribute to the delay of rehydration of children while they are still at home. Among the cases caregivers 64(84.2%) were able to describe to make salt and sugar solution and also 63(82.9%) of controls were also able correctly.

4.8.2 Knowledge of Caregivers on the prevention of Diarrhoea

On the prevention of diarrhoea among case caregivers 61(80.3%) mentioned boiling of water as compared to controls 57(75%) with an Odds Ratio 1.3(95%CI 0.63, 2.9) although it was not statistically significant. The use of Aqua tablets was indicated by 50(65.8%) among cases and 52 (68.4%) by controls caregivers. With the quality of Chakari water many people were not protected from diarrhoea. Washing hands before meals as a preventive measure of diarrhoea was indicated by 54(71.1%) among cases and 56(73.7%) of the controls. Washing hands after using the toilet was mentioned by 52(68.8%) of case caregivers and 57(75%) of the control caregivers. Eating food while hot was indicated by 54(71.1%) of the cases and while 57(75%) of the controls also mentioned the importance of eating food while hot. Twenty six (34.7%) of the case caregivers indicated that they had received health education on diarrhoea in the past six months and of the controls 25(32.9%) mentioned that they also received health education on diarrhoea.

Table 6: Knowledge levels of diarrhoea caregiver cases and controls in Chakari Mine

Variable	Cases N=76 (%)	Controls N=76(%)
Correct Definition of Diarrhoea	69(94.5)	58(76.3)
Cases of Diarrhoea		
Drinking contaminated water	63(82.9)	64(84.2)
Eating contaminated food	63(82.9)	66(86.8)
From the Air	6(7.9)	6(7.9)
Diarrhoea Management At Home		
First give salt and sugar solution	71(93.4)	69(90.8)
First give antibiotics	2(2.6)	2(2.6)

Visit clinic first before giving SSS	32(42.1)	34(44.7)
Prevention of Diarrhoea		
Boiling of water	61(80.3)	57(75)
Using Aqua tablets	50(65.8)	52(68.4)
Washing hands before meals	54(71.1)	56(73.7)
Washing hands after using the toilet	52(68.4)	57(75)
Eating hot food	54(71.1)	57(75)
Receiving H/education past 6 months	26(34.7)	25(32.9)
Described correct preparation of SSS	64(84.2)	63(82.9)
Child Status		
Immunisation status up to date	69(98.6%)	67(97.1)
Under nourished	12(17.6)	4(5.8)
Well nourished	56(82.4)	65(94.2)
HIV status Positive	2(3.1)	2(3)
Negative	36(55.4)	34(50.7)
Unknown	27(41.5)	31(46.3)

4.9 Hygiene practices of caregiver cases and controls in Chakari Mine

On the feeding of children with food prepared outside home within 7 days among cases 19(25.3%) only and also 20(26.7%) of controls and the majority did not feed outside their family homes. On the heating of food before eating when there is no electricity 28(50%) of the respondents caregivers of cases indicated that they were reheating and among controls 29(54.7%) were reheating their food. On the boiling of food water when there is no electricity among case caregivers 25(45%) were boiling and only 23(45.1%) also among controls boiled their water.

The practise of hand washing after using the toilet and before eating was mentioned by 71(93.4%) among cases and 72(94.7%) among controls. Hand washing after changing diapers or before feeding the child was indicated by 57(75%) among cases and 64(84.2%) among controls. Before handling food was mentioned by 68(89.5%) of cases and 70(92.1%) of the controls. Run to waste method of washing hands was both common among cases 64(97%) and controls 66(100%) of the respondents. The mentioned practices were mentioned but not observed as they may have been contributed by the outbreak of cholera which occurred in year 2008. The use of using one bowl when washing was significant at descriptive analysis with Odds Ratio 5.3(95% CI 1.36, 23) p=0.001.

On the reagents used for hand washing both case caregivers 14(18.4%) and controls 16(21.1%) used water only for hand washing. The majority 63(82.9%) of the cases and 68(89.5%) mentioned that they were using soap and water. Only 31(40.8%) of the case caregivers and 32(42.1%) of controls indicated that they were using ash and water.

Among the cases 18(23.7%) were using communal toilets and controls 21(27.6%) were also using the same ablution facilities. The equal number of caregiver respondents was using water system 38 cases and 41 controls. Thirty two (42.1%) of the cases used Aqua tablets to disinfect their water and it was mentioned by 37(48.7%) of the control caregivers. Twelve (15.8%) used water makers of the cases and 10(13.2%) of the controls. Case caregivers 14(18.4%) used water guard and it was mentioned by 17(22.4%) of the controls.

On the containers used for storage of water among case caregivers 30(52.6%) used narrow mouthed containers and of the controls 27(47.45) also mentioned them. The bucket with a lid were mentioned by the majority 60(78.9%) among case caregivers and 62(81.6%) among control caregivers.

4.10 Outbreak preparedness and response evaluation

Surveillance

Monthly and weekly thresholds were not available for both the Chakari Mine Clinic and the Sanyati District on diarrhoea. Weekly disease surveillance data was available T5 but was not being analysed. There were no any meetings which were being held at the clinic to discuss weekly disease surveillance data.

The diarrhoea cases for Chakari Mine Clinic surpassed the threshold in the week 12 in March 2011 unnoticed and it was self limiting and also increased in week 26. The sister in charge noticed the outbreak on the 12th of September 2011 in week 37 as they had more cases which were alarming so the outbreak detection was more than the interval of <3 days between the occurrence of the first case at the community and outbreak case at the health facility. This raised the initial alarm of a possible watery diarrhoea outbreak and the Nurse in Charge reported on the 14th of September 2011 to the District which was after 48 hours of which was well beyond the target interval of within 24hours.

The inadequate rapid response team which were composed of the DEHO and the DNO only went to Chakari to investigate on the 20th of September 2011 and the report of the investigation was not available.

On the 4th October 2011, another team of rapid response which included the DNO, HPO, DEHO and the 2 MPH officers went for an investigation in Chakari Mine to establish the existence of the outbreak of which even listing of cases were not available and was not being done. The time interval of recognising that they are in an outbreak and reporting to the next level was within the 3 day target. The Rapid Response team was dispatched to Chakari Clinic for preliminary investigations for the outbreak was well above the 48 hours target interval as they took 8 days. The interval between sending both water samples and stool specimens to

the laboratory was not within the 3-7 days as they were collected on the 7th of October 2011 of which there was an interval of 23 days. The notification of the Province from the district was within the targeted period of less than 7 days although there were no thresholds to prove that they were in an outbreak.

4.10.1 Availability of resources to respond to outbreak

The Chakari clinic had no enough manpower especially who were carrying out health promotion activities in the community and investigations of diarrhoea cases in the compound. They had inadequate Information Education and communication (IEC) materials as they had flyers and posters on prevention of Cholera only. They had adequate ORS but 200mls ringers lactate was not available. Half strength Darrow's dextrose which is ideal for rehydration of under fives was also inadequate. Fluids administration sets were available and only tape water was available. They had one ambulance and a motor cycle which was not enough for such an outbreak on communication there was a telephone and mobile phones of which were for personal use. They also had enough intravenous fluid giving sets and all gauge sizes of intravenous cannulas. On drugs they had Cotrimoxazole, amoxicillin and erythromycin but Nalidixic acid and gentamicin were no available. They had only 25kgs of high test hypochlorite (HTH) and they did not have Chloride of Lime. They were not having any form of personal protective equipment. The response to the outbreak interventions were delayed as only ORS only were being given at the clinic. Investigations and follow up were not being done due to shortage of manpower as there was only one EHT. Interventions were instituted in the community on the 18th of October 2011 with the assistance from partners who were Merlin Zimbabwe and Goal Zimbabwe on the door to door hygiene promotion awareness campaigns of watery diarrhoea to Chakari communities, distribution of IEC materials, Aqua tablets and ORS sachets per household and encouraging boiling of tape water as it was heavily contaminated.

4.0 Discussion

This study found out that eating of cold foods were risk factors which were associated with children under five to have suffered from watery diarrhoea of which it was statistically significant at 95% confidence interval. The foods involved were Sadza, porridge vegetables, salads, rice and beans. This indicates that there were multiple sources of infection and contamination other than personal hygiene. This study also found that the presence of flies at home was 5.1 times more likely to have result in a diarrhoea case [OR,5.3(95% CI 2,13.9)p=0.0006] and a home with a dump site near home was also a risk factor of diarrhoea cases with Odds Ratio 4.5(95% CI 2.1,9.7) p=0.0001. This indicates that flies may have been the immediate vector which transmitted the pathogens.

The caregivers who were employed were significantly 5 times likely to have a child with diarrhoea [OR 5(95%CI 1.04, 23.8) p=0.03], it indicates that their children were most likely to eat cold food as it was prepared in advance before going to work as reheating or eating food while hot destroys some of the pathogens and it renders the food to become safe for consumption.(3) Conducted a study on the aetiology of diarrhoea in the children less than five years of age in Ifaka Tanzania and found out that most of the watery diarrhoea 35.7% were being caused by Escherichia Coli. The water samples results for Chakari were found to be having unacceptable levels of E.coliforms.

Washing of hands in the same bowl was also statistically significant at 95% confidence interval to be associated with contracting diarrhoea with [OR 5.6(95% CI 1.4, 21.9) p=0.02]. This indicates that those who were washing hands in the same bowl were 5.6 times more

likely to have a case of diarrhoea as compared to the controls. This study reveals that most of the cases were not using the run to waste method when washing hands before eating food although they indicated that they were using soap and water. This shows that the spread of diarrhoea was being caused by poor food preparation and storage and unhygienic hand washing practices.(4) in his prospective clinical study of acute diarrhoea in children under five years 66% aged >1 month -2 years old recommended that health care personnel to emphasize to parents and caregivers about good hygienic behaviour to reduce the episodes of diarrhoea and the use of ORS every time when the children have diarrhoea episodes to reduce the disease severity.

This study found out that being knowledgeable about diarrhoea was associated with having a diarrhoea case with an Odds Ratio 5.4(95% CI 1.7, 16.7) p=0.001. This can be explained by the analysis of the delay in reporting to the clinic of children with diarrhoea in Chakari as had a mean delay of 1day only. This means those care givers with knowledge of diarrhoea were more likely to bring report to the clinic for their children to be treated in time as there were no cases which were recorded with severe dehydration during the outbreak. This could have been contributed by the health education given during the 2008 outbreak of cholera in the Chakari compound. This study also found that 64(84.2%) of case caregivers were able to describe the correct preparation of salt and sugar solution (SSS) and 60(78.9%) of the case caregivers had only salt at home. The unavailability of sugar at home contributed to the early reporting to the clinic so that they can access the ORS sachets. (5)Say ORT programme should move strongly towards promoting home treatment, building on local traditions of giving food based preparations with ORS availability from the health workers and health facilities for those who need it. This has been a major challenge on the distribution of ORS sachets to the families as they were being used for baking homemade bread because of the bicarbonate ingredients in the powder other than for rehydration.

(6)in their study in Thailand found out that when children had diarrhoea 65% of mothers sought help from the health providers. Home availability fluids were used by 14.4%.

Undernourished children were 3.5 times more likely at risk of having diarrhoea in the study [OR 3.5(95% CI 1.06, 11.4) p=0.03]. This finding is consistence with what was found by (7) in his study in Papua New Guinea that on preventive strategies of diarrhoea in children it should include breast feeding, ensure good hast defence by good nutrition, immunisation and early treatment of childhood and ensure satisfactory sanitation and hygiene.(8) Say malnutrition is the risk of contracting diarrhoea in the Sub-Sahara Africa of which epidemics are common in the areas.

On the multivariate analysis of the independent risk factors the children between the age group >12 months to 24 months were at more risk of have suffered from watery diarrhoea in Chakari mine of which those fed with cold porridge among cases were 28.7 times more likely to have diarrhoea as compared to the controls [AOR 28.7(CI 2.26, 362.8) p=0.01]. The percentage of the diarrhoea cases attributable to have eaten cold porridge was 96.5% Attributable Risk %(AR %). This is the age group which is mostly being introduced to solid foods especially porridge as due to shortage of electricity they were given porridge which was not pre-heated and without proper washing of hands.

Eating cold Sadza was an independent risk factor as the cases were 13 times more likely to have water diarrhoea as compared to controls. Children are likely to be given cold Sadza as they usually have extra food between meals which was cold as compared to the family meal which is eaten while hot. Those children who were given cold vegetables were 90% less likely to have suffered from diarrhoea with Adjusted Odds Ratio 0.1(95% CI 0.01, 0.9) p=0.05 (protective). This explains that in most cases vegetables can be served after preheating and in most cases it is not exposed to flies as it will be covered as in this study

again found out the presence of flies at home was a risk factor of contracting diarrhoea [OR, 5.3(95% CI 2,13,9) p=0.0006].

The final logistic regression model which included the significant foods and other environmental factors the only independent risk factor which was statistically significant at 95% confidence interval was washing hands using the same bowl of which cases of diarrhoea were 11.4 times more likely to have watery diarrhoea as compared to controls [AOR, 11.4(95% CI 1.89,70.1) p=0.08] this concludes that outbreak of diarrhoea in Chakari was a water washed outbreak of which its mode of transmission was a water borne which was being spread by soiled hands which were not properly washed before eating food this facilitated the passing of infection to the next person (9) in his study in Dhaka Bangladesh indicated that the enteropathogens isolated with childhood diarrhoea in 74.8% were E.Coli and Shigella species as compared to 43.9% of control children (p=0.0001).The stool samples for Chakari Mine diarrhoea outbreak also Shigella was isolated. (10)Reviewed control of diarrhoea disease and recommended hand washing with soap and water as it reduces diarrhoea episodes by 14-48%.

The knowledge of caregivers on the prevention of diarrhoea for both cases and controls they were aware of the importance of boiling water but it was not being practised even the use of aqua tablets as they thought that their tap water was safe while it was contaminated as shown by the results which had 90 coli forms per 100ml. Case caregivers 54(71.1%) and 57(75%) of controls knew the importance of eating food while hot but it was being compromised by the unavailability of electricity and firewood. On the heating of food when there is no electricity was mentioned by 38(50%) of case caregivers and 28(54.7%). This indicated reheating of food was not being practised by half of the respondents. The boiling of water was compromised as it was mentioned by 25(45.5%) of case caregivers.

The washing aspects were being observed by the majority of the respondents especially after using the toilet and before handling food but the aspect of use of a bowl on washing hands was an independent risk factor for contracting diarrhoea in Chakari Mine. The reagents used for hand washing the majority used soap and water as it has been proved that it reduces diarrhoea episodes.

The outbreak detection was delayed by the unavailability of diarrhoea thresholds both at Chakari Clinic and Sanyati District. The reporting of the outbreak to the next level was delayed due to unavailability of a line list of cases and Data. The response by the Rapid Response Team (RRT) was not prompt as expected to institute control and prevention measures. The collection of samples was delayed as the laboratory scientists were not being included in the RRT.

5.2 Limitations

The study was conducted with limited involvement and support from the laboratory to identify or isolate the pathogens which were causing watery diarrhoea. The samples send to Virology laboratory, results were not yet available after a month being sent to Harare. Further case control studies are being recommended for diarrhoea outbreaks in under five years where the potential enteric pathogens will be isolated as we think Rotavirus is causing these diarrhoea outbreaks.

5.3 Conclusion

The major risk factors in this study were cold food and the washing of hands using the same bowl. The study indicated that food preparation and storage was being compromised although the quality of water was not also fit for human consumption as it was contaminated. The health education and promotion of personal hygiene targeting washing hands technique and the safe preparation, storage and reheating of cold foods or eating food while hot need to be

emphasized in the messages to the community. The outbreak of diarrhoea was detected late of which control measures were delayed to be implemented. The community need to be informed about the extent of the contaminated tape water in Chakari Mine so that they can take preventive measures through awareness campaigns.

5.3 Recommendations

There is need for health education and promotion activities to promote washing of hands and safe food preparation, storage practices and the eating of food while hot. The Health Promotion officer(s) need to conduct the water quality and monitoring Audit periodically. The management should do an overhaul of the water piping system in Chakari-Mine Management-Mine Management. There is need to develop the District and Clinic diarrhoea Disease thresholds for early response and also to capacitate and involve the local laboratory into the District Rapid Respond Team.

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