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DIARRHEAL DISEASES IN CHILDREN UNDER 5 YEARS: A CASE OF MARONDERA DISTRICT, MASHONALAND EAST PROVINCE, ZIMBABWE, 2021

BY

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTERS OF PUBLIC HEALTH IN THE COLLEGE OF HEALTH AGRICULTURE AND NATURAL SCIENCES OF AFRICA UNIVERSITY

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Abstract

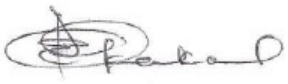
Diarrhoea l challenges globally, are a hindrance and are the 2nd leading cause of death in children under 5 years. There was a noticeable increase in number of diarrhea l cases in Marondera district during week 7 (136 cases) in 2021. The research wanted to determine the risk factors associated with diarrhea. The main purpose was to be able to institute early intervention measures, control the outbreak and provide the necessary resources. The precede-proceed conceptual framework model was used. The researcher used a probability systematic random sampling case control study design of 35 cases and 35 selected into the study. An interviewer administered questionnaire was used to collect data. Medical records such as OPD cards were checked to confirm their self-report on diarrhea and registers especially T12 were checked as well to confirm eligibility of the diarrhea cases. The quality check of the data was done during the field visits. Quantitative data amassed was also processed using SPSS and analysed using Epi Info 7. The results showed that the mean age was 26.3 months, no statistical significance between level of education and developing diarrhea. There was some association between religion and getting diarrhea, Chi-square value 9.1, df =3 and p-value = 0.028. Using open well when there was water cut had significant association for getting diarrhea OR = 11.62, CI = 3.35 -40.23, p = 0.00023, while having no water cuts had minimal protective effect from getting diarrhea OR = 0.07, CI = 0.015 – 0.35 and p = 0.00023. Burst sewer pipes, non-refuse collection had significant association with getting diarrhea. In conclusion, contaminated water from open wells, burst sewer pipes and none refuse collection were major risks associated with contracting diarrhea in under 5 years children in Marondera. As a result, water cuts should be minimised, residents informed in advance so that they can store water in closed containers for use, encouraged to boil the water and politicians to drill boreholes. The municipality to urgently attend to burst and leaking sewer pipes and collect refuse frequently.

Keywords: Diarrhea, children, risk factors, water and sewer.

Declaration

"This dissertation is my original work and has not been presented for a degree in any other university."

Plaxedes Mutubuki		29/ October 2022
Name of Student	Signature	Date

Mr E Chikaka		29/ October 2022
Name of Supervisor	Signature	Date

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I would like to acknowledge the presence of the Almighty in my life for he is responsible for everything that l have achieved in this journey. It is my wish to thank various personalities who helped me arrive at the completion of this document and satiating the necessary and required detail. My daughter Gamuchirai and son Tsungai for their unwavering support financially and morally. My colleagues, Simon, Ireen, Owen for all their support academically. Lastly my greatest appreciation goes to my academic supervisor Mr E Chikaka for pushing me throughout my research.

Dedication

The author dedicates this report to her beloved daughter and son, family and friends for their unwavering support throughout to date.

ABBREVIATIONS AND ACRONYMS

DALYs	Disability Adjusted Life Years
DHE	District Health Executive
DMO	District Medical Officer
FCH	Family Child Health
IVI	Intravenous injection / infusion / cannula
MOHCC	Ministry of Health and Child Care
NGT	Naso-gastric tube
OPD	Outpatients department
ORS	Oral rehydration solution
PHE	Provincial Health Executive
PMD	Provincial Medical Director
PRECEDE	Predisposing, Reinforcing and Enabling, Constructs in Educational / Environmental Diagnosis and Evaluation
PROCEED	Policy, Regulatory and Organizational Constructs in Educational and Environmental Development.
QALYs	Quality Adjusted Life Years
RDNs	Rapid disease Notification Systems
SSA	Sub Saharan Africa
SSS	Salt Sugar Solution
UNICEF	United Nations International Children Emergency Fund
WHO	World Health Organisation

Key Definition of Terms

Agent: Originally referred to as infectious microbes, (micro-organisms, microbial, physical, psychosomal, chemicals), virulence, how organisms grow/ multiply and spread.

Biological factors: Micro-organisms that transmit the agent-salmonella, vibrio cholera, shigella etc

DALYs: Disability Adjusted Life Years- disease or illness will cause morbidity or mortality if no intervention thereby cutting down on number of years to live but if preventive and control measures are put in place children's lives will be improved.

Dehydration: Loose of fluids in the body, which can be no dehydration, some or severe dehydration noted by changes in skin tagger, consciousness, alertness and convulsions.

Diarrhea: Passage of watery / loose stool 3 times or more per day.

Epidemiologic Triad: Agent, Host and Environment.

Environmental factors: Agents on their own will not be successful in their bid to infect host without suitable environment, which allows growth, multiplication and transmission of disease, otherwise it dies.

Host: Person infected by an agent is the host, depends on the person's defense mechanism that is specific- immunity system / suffered the disease or non-specific such as skin, genetic, secretions, mucus membranes, hormones, nutrition, behavioral pattern and sex (gender), immune-suppression due to HIV /malnutrition / chemotherapy /malignance and ageing.

Physical factors: Such as climate, altitude, surrounding.

QALYs: Quality Adjusted Life Years- quality and quantity of life lived, if you get an intervention, you live longer, you divert resources to where you expect longer life for example an under 5years verses 70 years old. Developed by economists, primarily used in cost effectiveness analysis, to guide decisions regarding distribution of limited health care resources, interest, clinical management and individual patient care.

Socio-economic factors: Such as over-crowding, sanitation, water availability, hygiene, income status (low / middle income) health facilities / services- accessibility, availability, affordability, appropriate, acceptability by community norms, values, beliefs, attitude, practices, culture and religion.

Table of contents

List of tables

List of Figures

List of appendices

CHAPTER 1 INTRODUCTION

1.0 Introduction

Diarrhea, also spelled diarrhoea, is the condition of having at least three loose, liquid, or watery bowel movements each day. It often lasts for a few days and can result in dehydration due to fluid loss. Loose but non-watery stools in babies who are exclusively breastfed, however, are normal. The most common cause of diarrhea is an infection of the intestines due to either a virus, bacterium, or parasite—a condition also known as gastroenteritis. These infections are often acquired from food or water that has been contaminated by feces, or directly from another person who is infected.

There are three (3) types of diarrheas that include: short duration watery diarrhea, short duration bloody diarrhea, and persistent diarrhea (lasting more than two weeks, which can be either watery or bloody). The short duration watery diarrhea may be due to cholera, and if blood is present, it is also known as dysentery. There are also a number of non-infectious causes can result in diarrhea. These include lactose intolerance, irritable bowel syndrome, non-celiac gluten sensitivity, celiac disease, inflammatory bowel disease such as ulcerative colitis, hyperthyroidism, bile acid diarrhea, and a number of medications. Diarrhea can be prevented by improved sanitation, clean drinking water, and hand washing with soap. Breastfeeding for at least six months and vaccination against rotavirus is also recommended. Oral rehydration solution (ORS)—clean water with modest amounts of salts and sugar together with Zinc tablets are recommended as the treatment of choice. When people have diarrhea, it is recommended that they continue to eat healthy food and babies continue to be breastfed. For those who cannot afford commercial ORS, it is recommended that homemade solutions may be used.

1.1 Background Information

There are numerous risk factors associated with contracting diarrhea for children under the age of 5 years; the author generated this research based on global burdens, regional, national, provincial and zeroed down to her district Marondera. All these burdens compelled her to conduct this research at her district where she was attached. The background information as indicated from global to district level was analyzed and clearly indicated why such a study should be carried out in Zimbabwe in Marondera District.

1.1.1 Global burden of diarrhea

Diarrhea globally has been the second leading source of death in children under 5 years, though it is preventable and treatable, but it remains a common illness that is killing about 2 195 children every day and yearly 525 000 more than HIV /AIDS, malaria and measles combined (Danaei, et al., 2016). Diarrhea l diseases account for 1 in 9 child deaths worldwide. For children with HIV /AIDS, diarrhea is even more severe and the death rate is 11 times elevated than those children without HIV / AIDS (Naghavi, Abajobir, Abbafati, Abbas, Abd-Allah, and Fischer; 2017) and (WHO, 2008, 2009). A lot of children were dying from rotavirus, vibrio cholera, typhoid and dysentery, poor hygiene practices, poor sanitation, unsafe water supply, resulted in strides having been made during the past 20 years which include rotavirus vaccination, breast feeding, and the prevention focused on safe water supply, improved hygiene and sanitation, of which these are cost effective, prevention is simple / less expensive than cure (Otsuka, Agestika, Widyarani, & Yamauchi, 2019).

Every year there are nearly 1.7 billion childhood diarrhea l cases. Diarrhea also causes malnutrition in children below 5 years. Currently, it is the leading cause of mortality and morbidity in the world, mostly resulting from contaminated food and unprotected water sources. Worldwide about 780 million individuals have no access to clean / safe drinking water and 2.5 billion lack sanitation (Acacio, et al., 2019). Diarrhea infection in developing countries is widespread, due to poverty, the children may have many episodes of diarrhea every year and this will deprive the child of the nutrition necessary for body growth and development, resulting in malnutrition-wasting and stunting (Baker, et al., 2016).

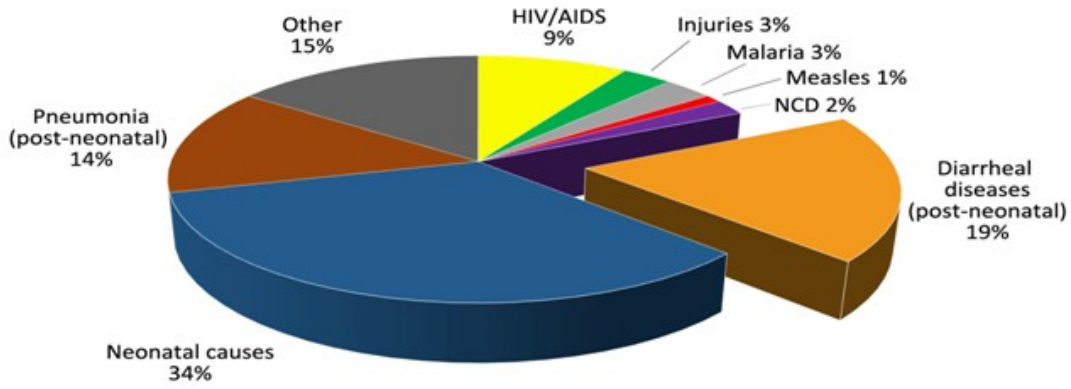

Figure 1: Distribution of deaths caused by different diseases (Danaei, et al., 2016)

These diarrhea l diseases can be prevented through clean safe drinking water, good sanitation, hand washing hygiene and improved nutritional status, use of oral rehydration solution (ORS) (WHO, 2017 and 2021). Global health community came up with prevention and treatment priority whereby WHO and UNICEF co-ordinated the diarrhea and pneumonia intervention study group that developed the global action plan for the prevention and control of pneumonia and diarrhea, aimed at reducing incidence and deaths due to diarrhea by 2025 (Niyibitegeka, Riewpaiboon, Youngkong, & Thavomcharoensap, 2021).

1.1.2 Regional burden of diarrhea

Over the years diarrhea was ranging from 8th position and above as of 2016 going back in regards to causing death in all age groups and the 5th leading cause of death among children under 5 years, 446 000 deaths, with mortality rate of 22.4 deaths per 100 000, girls with higher rate of 9.02% - 10.47% while boys with 7.58%-10.22%. The highest rate of diarrhea mortality occurred in Chad were 499 deaths per 100 000 was recorded, Central African Republic 384.2 deaths per 100 000 and Niger 376 deaths per 100 000 (Nhampossa, et al., 2015). Diarrhea was accountable for 8.92% of all deaths in children under 5 years in Africa (Troeger, et al., 2018).

Rotavirus accounted for 128 515- 228 047 deaths, hence was the leading aetiology for diarrhea l mortality and morbidity among children under 5 years, clostridium difficile was responsible for the fewest deaths 1 958 deaths, shigella 212 438 deaths and vibrio cholera 107 290 deaths (cholera) was the third leading cause of death (Larson, Saha, Islam, & Roy, 2006).

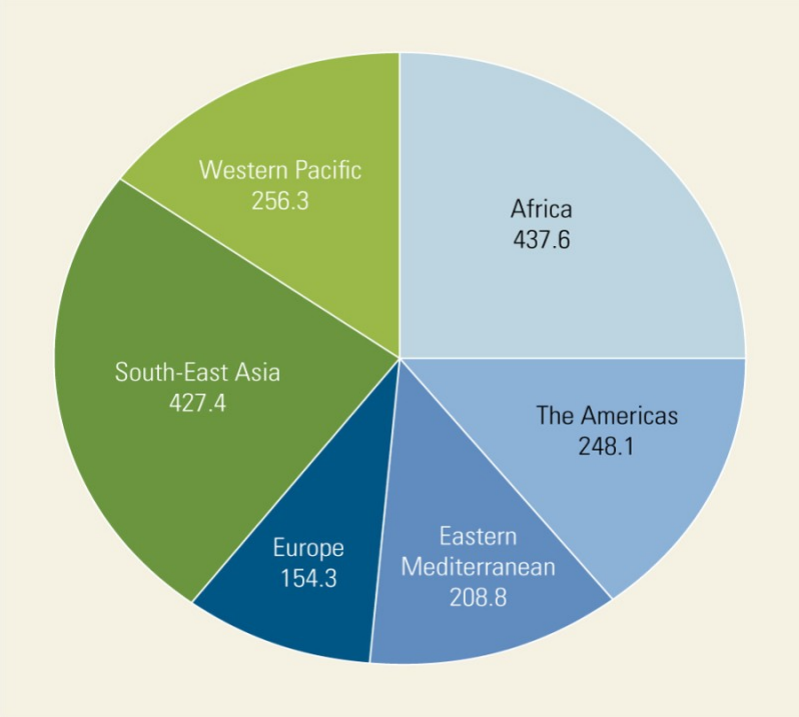

Figure 2: Pie chart showing number of deaths recorded in various regions (Troeger, et al., 2018)

The leading risks for diarrhea in children were unsafe water for both drinking / cooking / washing, unsafe sanitation- no or lack of toilets plus hand washing facilities (unhygienic factors) were responsible for 80.4% and 72.1% diarrhea l deaths in children under 5 years (Troeger, et al., 2018) (Magdalena, Rantetampang, Pongtiku, & Mallongi, 2019). More than a quarter (26.93%) of these diarrhea l diseases occur in children under 5 years, whilst 90% occur in South Asia and Sub-Saharan Africa, these are developing countries. Hence developing countries their disease disproportion which affects locations with poor access to health care, safe water, sanitation, low- income or marginalised population (Troeger, et al., 2017).

Diarrhea was the 3rd leading cause of DALYs in 2016, responsible for 74.4 million DALYs, with 40.1 million (63%) of them occurring in children under 5 years. The case fatality ratio (CFR) of disease incidence and mortality is high in SSA due to high burden of TB / HIV / AIDS in these regions. The introduction of the rotavirus vaccine contributed to a reduction of 7% in mortality due to diarrhea in the high-income super region (6.8%), more than 6% in Latin America and the Caribbean 6.2%. Preventive measures include provision of safe water supply, use of ORS and hand hygiene to mention a few (Mandomando, et al., 2007). The risk factors included wasting, unsafe water, unsafe sanitation, lack of hand washing, dehydration and lack of therapeutic zinc, these should reach many children in order to avert one diarrhea death in SSA.

So there is need to boost coverage and accessibility of ORS, support of rotavirus vaccine by GAVI Alliance since it is the leading etiology responsible for diarrheal incidence and mortality (Howard, Walls, Bell, & Mounier-Jack, 2018), brought about 2.6% decrease in mortality and thereby prevented 27 000 deaths in 2016 (Pecenka, et al., 2020).

1.1.3 National burden of diarrhea

Mashonaland Central is the highest, on top as far as diarrheal incidence in Zimbabwe is concerned with 87.5 per 100 000 population, followed by Mashonaland East 76.0 and lastly Manicaland with 73.7 per 100 000 and the other province were alright (Moy, de C, Choto, McNeish, & Booth, 1994).

In October 2011 – 12 Aug 2012 the country experienced typhoid fever in Harare, City, spread to Bulawayo, Bindura in Mashonaland central, Mashonaland west – Zvimba and Chegutu, Midlands – Chirumhanzu district, Chitungwiza – Seke in Mashonaland East – Marondera district areas. Chitungwiza had 200 cases with 2 deaths recorded. According to 2019 herald report by Lisa Shirichena, 365 people died of diarrhea out of 322 644 cases, 6 deaths were from the under 5 years, Marondera district had 7, Hurungwe 4, Chegutu 2, Mhondoro 2 and Parirenyatwa Hospital 1 death. Masvingo recorded 1 715 the highest number of diarrheal cases followed by, Manicaland with 1 597. Diarrheal cases remain high because their determinants which include safe water, sanitation and hygiene remain unavailable or continue to have very low coverage's (Maponga, et al., 2013).

According to Simango (2000) in July 2000 the city of Harare was hard hit by Salmonella enteritidis diarrhea, the pathogens were secluded to detect sensitivity most were sensitive to gentamycin / ciprofloxacin and ceftriaxone and resistance to cotrimoxazole / nalidixic acid, ampicillin and chloramphenicol. In 2011 Kadoma experienced a spike in diarrheal cases from 27 during week beginning 5 September to 107 during week beginning 26 September same year, above the threshold, at the children's clinic in Rimuka (Maponga, et al., 2013), this outbreak resulted from inadequate clean water and use of contaminated water (unclean water). On 26 June 2020, the city of Bulawayo had diarrhea outbreak which killed 9 people out of more than 1 500 cases, residents had gone for months without tap water, forcing them to dig shallow wells and boreholes that have been contaminated by raw sewage flowing

from burst pipes, resulting in recurring outbreaks of diarrhea and cholera (Maponga, et al., 2013). On 12 November 2020, the city of Bulawayo reported more than 3000 diarrheal cases from Luveve / Magwegwe / Mzilikazi suburbs and the situation caused a major public health concern in the wakes of Covid- 19 pandemic.

This situation has been alluded to acute water shortages in the past 4 years because the city did not receive adequate rains, with few residents receiving water one day per week, while other suburbs did not get the water at all due to high gravitation, hand washing becomes compromised in such scenarios (Maponga, et al., 2013)

1.1.4 Provincial burden of diarrhea in Mashonaland East

Mashonaland East Province is the second leading province with 76.0 per 100 000 diarrheal incidences, with Mashonaland Central highest having 87.5 per 100 000 cases.

Table 1: Distribution of diarrheal incidences in Mashonaland East Province 2021

District	Week								
	1	2	3	4	5	6	7	8	9
Chikomba	26	25	17	20	21	25	6	21	11
Goromonzi	151	79	78	65	78	83	61	89	83
Wedza	32	18	45	30	20	22	15	32	7
Marondera	69	45	38	37	41	43	136	33	33
Mudzi	65	59	59	70	51	76	74	68	61
Mrewa	77	65	58	51	49	66	58	43	39
Mutoko	55	42	32	35	29	31	33	35	28
Seke	83	76	65	67	56	49	36	32	35
UMP	31	40	34	27	28	35	37	38	22
Total	589	451	426	402	373	430	456	391	319

From the 2021 statistics above, Goromonzi, Mudzi and Seke districts are topping up with diarrheal cases in under 5 years. No deaths were recorded as at 29 April 2021.

1.1.5 District burden of diarrhea

Marondera District, like any other districts in the province is faced with diarrheal problems in under 5 years, mainly from Nyameni, Dombotombo, Nyembanzvere clinics due to erratic water supplies in the town resulting from power cuts thereby failing to pump water, in turn affected hand washing, sanitation and drinking water.

Marondera district is one of nine districts in Mashonaland East Province. It is 74kms to the east of Harare and 48kms from Marondera town. The district is divided into 33 wards, of which 11 are urban and 22 are within the rural and commercial farming areas. It shares boundaries with Seke to the west, Wedza to the south, Makoni in Manicaland to the east, Mrewa and Goromonzi to the north. It has a total population of 195 751, of which 3.29% (6 444) are under ones, 11.34% (22 198) are 1-4 years and 14.63% (28 642) are under 5 years children. Dombotombo municipal clinic has the highest population of 37 588, followed by Nyameni municipal clinic which has 21 843 and Nyembanzvere council clinic with 13 192. Marondera gets its water supply from Wenimbe and Rufaro dams to supply Marondera town and its suburbs enjoy taped water. Marondera Municipal Health department is responsible for the implementation of health delivery services/ system to the urban population.

The district has 24 health facilities which include Marondera Provincial Hospital and Mahusekwa District Hospital which are referral centres for all the clinics. There are 2 prison clinics, 1 ZRP clinic, 8 government facilities, 8 council clinics, one private clinic, 2 mqunicipal clinics, 1 private hospital, 1 mission clinic, as well as private surgeries in Marondera town and PSMAS clinic too. The 2 major hospitals serve as the admitting institutions for all diseases including diarrhea. Diarrhea burden ranks as the 2nd among the top 5 diseases in under 5 years and some of them are ARI, injuries, malaria and malnutrition.

1.2 Problem statement

There was a noticeable increase in the number of diarrheal cases in under-fives in Marondera District. According to Rapid disease Notification System (RDNs-Weekly Notifiable disease and DHIS2), the following cases were reported from the first week of January 2021 to 4 April 2021.

First week of January recorded a large number of 69, this was then followed by a spike / rise of cases in week 7 and another extreme value in week 13 of 57 records.

The main cause of the rise in cases during this period was not known hence the need to carry out an investigation. Figure 1.1 below shows the graphical presentation of these cases from week 1 to week 13 of the year 2021.

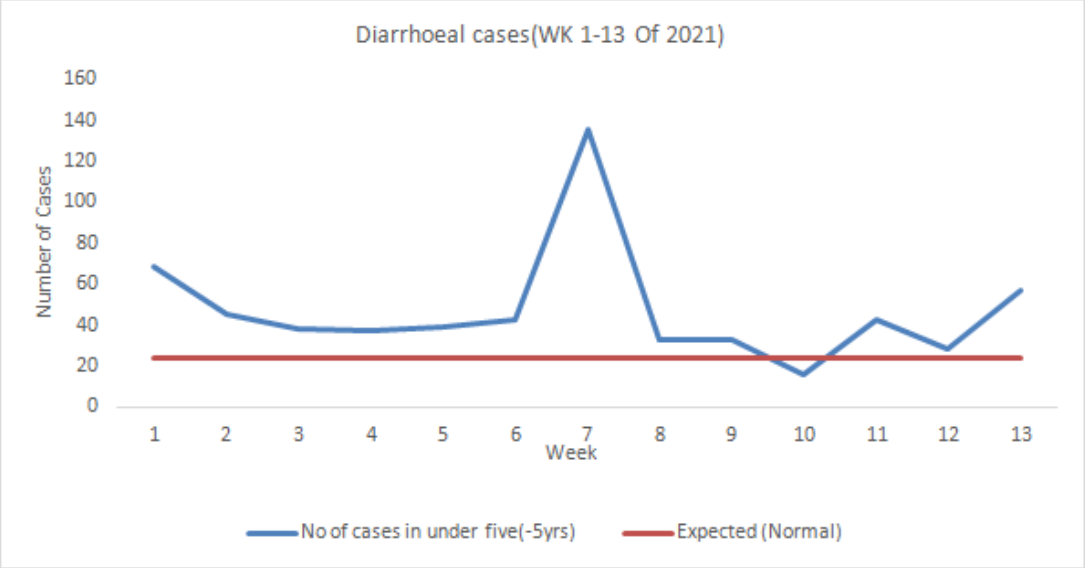

Figure 3: Graphical presentation of the Diarrhea cases in Marondera in year 2021 (Normal expected = 24)

1.3 Purpose of study

The purpose of the study was to determine the risk factors associated with contracting diarrhea in children under-fives in Marondera District from January to April 2021.

1.3.1 Specific objectives

The study sought specifically to:

i. Determine the socio-demographic factors associated with contracting diarrhea in children under-fives in Marondera District from January to April 2021.

ii. Assess the knowledge, habits and practices of parents / caregivers.

iii. Identify institutional factors associated with contracting diarrhea in children under-fives in Marondera District from January to April 2021.

iv. Assess water, sewage and drainage situation in Marondera District from January to April 2021.

1.4 Research questions

The research questions for the study were:

i. What are the socio-demographic factors associated with contracting diarrhea in children under-fives in Marondera District from January to April 2021?

ii. What are the knowledge levels, practices and habits of parents / caregivers that are associated with contracting diarrhea in children under-fives in Marondera District from January to April 2021?

iii. What are the institutional factors associated with contracting diarrhea in children under-fives in Marondera District from January to April 2021?

iv. What was the water, sewage and drainage situation like in Marondera District from January to April 2021?? (Functional, burst, blocked or leaking).

1.5 Significance of the study

The study helped identify the risk factors for contracting diarrhea and then addressed them in order to reduce diarrhea l incidence, mortality and morbidity in addition improve the QALYs of children, thereby save life. The antimicrobial resistance was determined so that appropriate antibiotics were prescribed to the people according to sensitivity results. More so, health education was given accordingly for example clean safe water supply, good sanitation, hand washing / hygiene after use of toilet / before and after eating or handling food just to mention a few .This also improved availability of ORS, rotavirus vaccine, management guidelines for diarrhea , drilling of more boreholes and protected wells too, as well as improved staff capacity

building, hence benefiting both the community at large, the participants, staff at centres studied, health management members (DHE, PHE and MOHCC). Most water borne diseases manifest from challenges around the host, agent and the environment, so the study wanted to check and confirm whether the same scenario surrounds diarrhea in children under 5 in Marondera district or not and made inferences, suggestions and recommendations accordingly.

The study helped in picking outbreaks early through use of case definitions, investigate, confirm cases- clinically and laboratory tests, manage cases according to guidelines, institute early intervention measures, control the outbreak, provide necessary resources, report writing and account for the funding. This also creates an opportunity to improve on the pillars / principles of PHC too such as community participation, multi-sectoral loom, equitable distribution of resources, appropriate technology and preventive/ promotive approach

1.6 Delimitations of the study

The study was confined to Marondera District in Mashonaland province and all inferences are not meant for anything outside the boundaries of Marondera district.

1.7 Summary

This chapter looked at the diarrheal burden globally, regionally, nationally and locally, highlighted 2021 statistics, problem statement, and objectives of the study, research questions, significance and limitations of the study.

CHAPTER 2 REVIEW OF RELATED LITERATURE

2.0 Introduction

This chapter reviewed the literature that was used throughout the study, explored what others have done, identified gaps, filled in the gaps where possible and made reference to previous authors work and made a summary. Diarrhea continues to be a significant public health problem in developing countries like Zimbabwe, particularly among children. Diarrhea in children under 5 years is classified into three categories.

2.1 Conceptual framework

This study utilized the proceed conceptual frame work adopted from Green et al (2005)

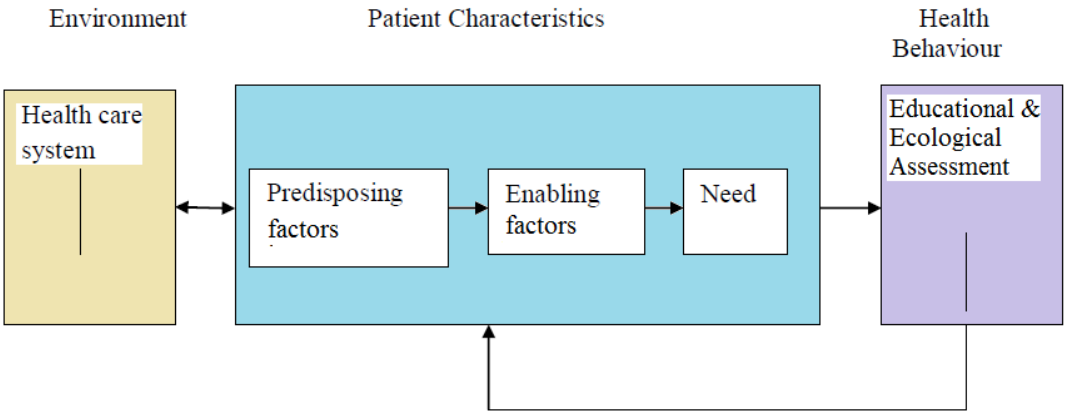

Figure 4: Health care utilisation model modified to describe treatment seeking and adherence (Green et al 2005)

The phases helped the author to identify factors contributing to disease such that targeted interventions can be planned. The factors are divided into environmental, patient characteristics-predisposing, enabling, reinforcing, need, health behavior-educational and ecological assessment. Also includes family and community support, economic climate and politics in the area.

Environment:

Changes in climate conditions such as increase in temperature, rainfall patterns, cyclones affect crop production resulting in hunger, malnutrition and diarrhea.

1) Patient characteristics- represent the knowledge – if the parent / guardian is educated, one is bound to act accordingly, in a positive attitude or manner, practices breastfeeding, hygienic preparation of the infant's food, good sanitary behavior becomes very crucial and resources available to the patient's disposal.
2) Predisposing factors- are pre-existing conditions that makes one susceptible to disease like low resistance due to HIV, age, malnutrition, gender, marital status, religion, education, occupation, knowledge, beliefs, practices and attitudes that people have.
3) Enabling factors- are antecedents to the behavior / environmental change that allow a motivation or environmental policy to be realized. It includes family issues like income, medical insurance, source of care, transportation, means of travel, waiting time at health facility, social support& supervision and relationships with caregivers.
4) Reinforcing factors- are the factors following a behavior that proved continuing reward or incentive for the persistence or repetition of the behavior. Normally good behavior is the one that is rewarded while the bad behavior is punished for.
5) Need- the ill person infected by an agent is the host, depends on the person's defense mechanism that is specific- immunity system / suffered the disease or non-specific such as skin, genetic, secretions, mucus membranes, hormones, nutrition, behavioral pattern and sex (gender), immune-suppression due to HIV /malnutrition / chemotherapy /malignance and ageing. It is the illness that is going to force the patient to seek care, at times depending on severity, signs and symptoms, underlying factors, family support, diet. Nowadays we have VHWs within the community who provide immediate care for free and refer emergence

cases to the clinic / hospital or even call for an ambulance. Moderate to severe cases are admitted and managed in hospital until recovered, and then educational + ecological assessment is done before discharge of the patient.

6) Educational and ecological assessment is done by giving information about disease/ condition, causes, control and prevention so that reoccurrence is minimized / reduced. At times policy makers, regulatory law bodies are involved as law enforcement agencies and a home visit is done to assess home environment too, trace conducts so that they are also screened, tested and treated as well.

2.2 Diarrheal disease classification

These include diarrhea with no dehydration, with some dehydration and with severe dehydration (WHO, 2021).

Table 2: Diarrhea classifications, symptoms and their management methods

Dehydration	**Signs and Symptoms**	**Management**
Severe dehydration	Lethargy / unconsciousness	Admit child
	Sunken eyes	Fluid replacement through IVI or NGT tube
	Unable to drink/ drinks poorly	Give antibiotics according to sensitivity results.
	Skin pinch goes back very slowly	Continue to give breast milk, reassure mother.
Some dehydration	Restlessness	Observe at clinic
	Irritability	Replace fluids per NGT or Orally
	Sunken eyes	Monitor feeding until stable.
	Drinks eagerly / thirsty	Can go home when stable.
		Review after 3 days / PRN.
No dehydration	Stable child, feeding well	Manage as an OPD
	Well hydrated	Continue breastfeeding
		Give ORS at home
		Review after 3 days / PRN.

Diarrhea with no dehydration in any child less than 5 years of age with diarrhea and not enough signs to classify as some or severe dehydration (WHO, 2021). Diarrhea with some dehydration has been defined as any child less than 5 years with diarrhea and two or more of the following signs; restless or irritation; drinks keenly,

dehydrated, and skin pinch return back slowly. Diarrhea with severe dehydration in any child less than 5 years with diarrhea plus any two of the following signs lethargic or unconscious, sunken eyes not able to drink or drinking poorly and skin pinch return back very slowly (Varughese, Vakil, & Phillips, 2013). When diarrhea is chronic it is accompanied by symptoms such as abdominal pain fever or passing of blood or mucous (Ramirez, et al., 2020). This may be suggestive of HIV dysentery and amoebiasis, and giardiasis.

The underlying root of diarrhea may produce fever, abdominal cramps, weight loss, nausea and vomiting. People living in certain areas are usually adjusted to commonly found bacteria in their environment. Although most infectious diarrhea are brief illness, some do not go away after a few days (Bado, Susuman, & Nebie, 2016). More serious forms can be caused by microbes such as amoebae and giardiasis, which can become established in bowel and cause problems that persevere for weeks or months infected food or water is possible sources of these infections. Infectious diarrhea can have serious consequences in certain persons like young infants. Simple infectious diarrhea is still a major killer in underdeveloped countries, where infections of the bowel are estimated to cause millions of deaths annually among infants. Diarrhea can be caused by bacteria like shigella or Escherichia coli due to a simple infection, usually caused by a virus for example Rotavirus. These can cause fairly severe diarrhea with vomiting, abdominal cramping and fever (Bauhofer, et al., 2020). It is true that contaminated food or water remain the possible causes of diarrhea in both adults and children. As such safe adequate water supply should be advocated for and food needs to be cooked thoroughly, saved and eaten whilst hot. Routine rota vaccine schedule in under five vaccination is there in Zimbabwe and other countries as well.

Acute diarrhea worldwide constitutes a major cause of morbidity and mortality, especially among the very young children. In the United States it is estimated that

each year, adults experience 99 million episodes of acute diarrhea or gastroenteritis, resulting in about 8 million physicians visits and more than 250 000 hospital admissions each year (1,5% of adult hospitalizations) caused by acute diarrhea or gastroenteritis. Most cases are caused by enteric infections (Abuzerr, et al., 2020). Food and waterborne outbreaks involving a relatively small subset of population and recurrent bouts of illness in others compromise most cases (Bado, Susuman, & Nebie, 2016).

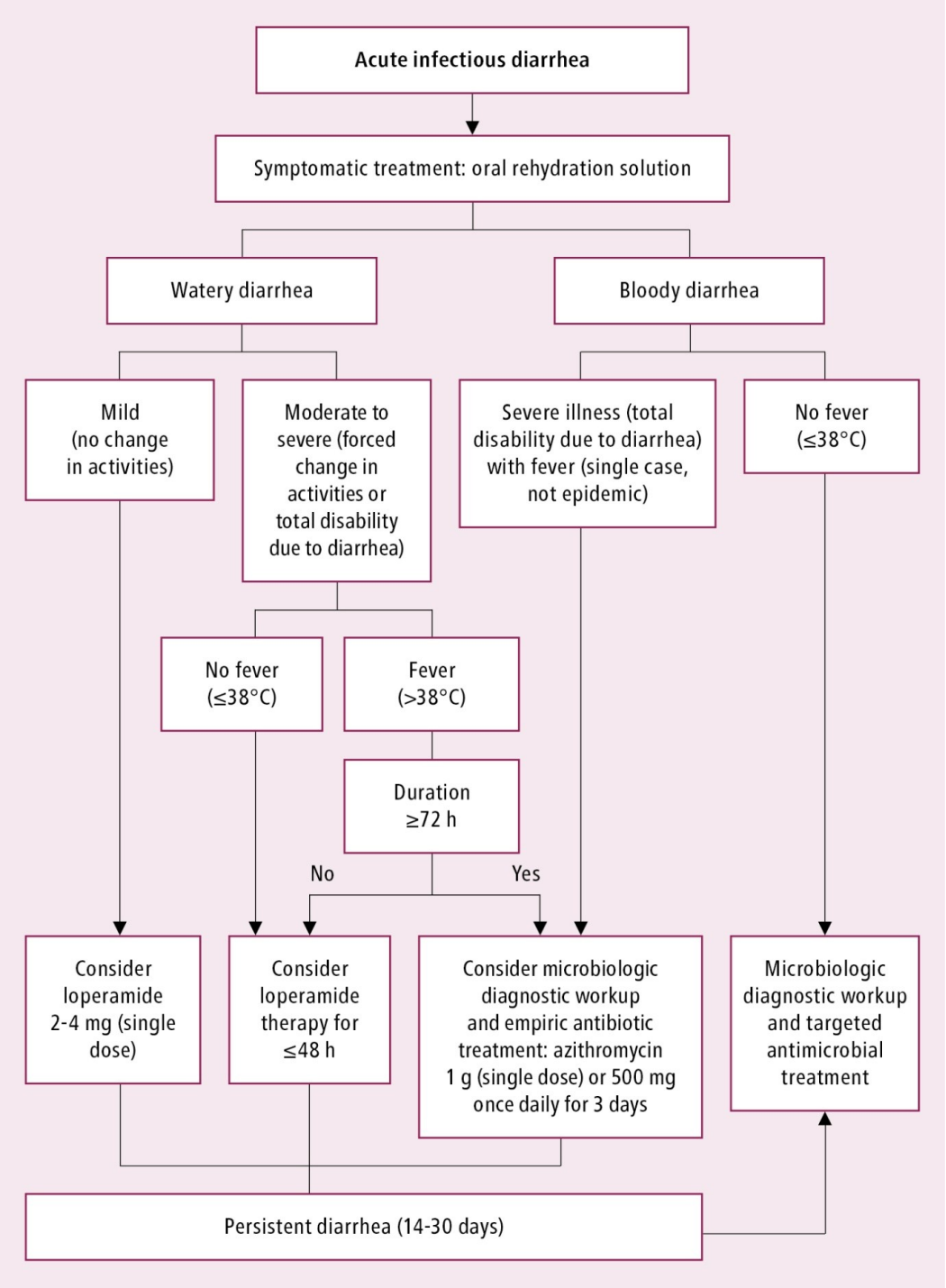

Figure 5: Diarrhea classification (WHO, 2009)

Diarrhea is more prevalent among adults who are exposed to children and non-toilet trained infants, particularly in a day care setting. It is more prevalent in travellers to areas with outbreaks, persons with underlying immune suppression, those living in non-hygienic environments with exposure to contaminated water or foods (Chang, et al., 2017).

Clinical features sometimes provide a clue to the cause. Diarrhea caused by small intestine disease is typical high volume, watery and often associated with malabsorption. Dehydration is frequent (Acacio, et al., 2019). Diarrhea caused by colonic involvement is more associated with frequent small volume stools, the presence of blood in stool (dysentery) requires antibiotics and a sensation of urgency (Crews, et al., 2015).

2.3 Contributory factors to diarrhea

Factors that contribute to diarrhea outbreak include travel history, sources of water (for example unprotected well) or contaminated water, lack / poor sanitation, poor hygiene especially hand washing, presence of burst sewage pipes, recent food intake, clinical signs and symptoms are history of profuse diarrhea episodes, dehydration, fever, nausea, vomiting and abdominal pain (Alambo, 2015) (Masanja, et al., 2019). Other clinical features include abrupt versus gradual onset of symptoms, symptoms duration, including bowel movement frequency, stool quantities, dysentery with fever, signs of fluid volume depletion, including thirst, tachycardia, decreased urine output, loss of skin turgor and lethargy / unconsciousness or confusion or both (Alemayehu, Ayele, Kloos, & Ambelu, 2020). The environment that is not hygienic, no toilets exposure to infected adults and contaminated water or food also causes diarrhea. Hence parents should toilet train their infants, infected adults seek early treatment and reduce / minimise travel to outbreak areas. Some patients have these contributory factors, so a detailed and thorough history taking would be necessary, but let us not forget that others may be symptomless so a thorough physical examination would help to reach a proper diagnosis and appropriate treatment.

2.4 Risk factors for diarrhea

Epidemiological risk factors should be investigated for certain diarrhea diseases and their spread (Thiam, et al., 2019). They include recent travel to an area with diarrhea

outbreak, day-care centre exposure, consumption of for example unpasteurized milk products, or a history of other infected ill people in a shared accommodation. The history should include place of residence, drinking water (treated city water or well water), rural conditions, with consumption of raw milk (Wang, Zhan, & Liu, 2021).

Faecal testing should be performed in patients with a history of diarrhea longer than 1 day who have the following symptoms: fever, bloody stools, universal illness, recent or remote antibiotic treatment, hospital admission, or signs of dehydration, as described earlier (Bauhofer, et al., 2020). Children aged under 5 years estimated to be 1.8 million continue to die because of diarrhea every year.

A study was done by Mbonye, (2011), to find risk factors for diarrhea among children under two years in Sembabule district, Uganda, revealed that the absence of latrine in a house (OR=1.4, $p < 0.03$), low knowledge of mixing oral rehydration salts (OR=1.7, $p < 0.01$), garbage thrown anywhere around the house OR=2.6, $p < 0.001$), not washing hands after using latrine (OR = 1.8, $p < 0.03$), and not washing hands before preparing food (OR=1.4, $p < 0.04$) were risk factors for diarrhea . Low immunization status was an important risk factor for diarrhea. The study showed that 49.5% of children were taken to health units for care and the rest had to seek treatment elsewhere. There is also a need to design focused health education messages to the caregivers to improve childhood diseases. These risk factors are very true, and applies to our own country of Zimbabwe as well (Mbonye, 2004). In some rural homes there are no water toilets to use, no wells hence no water for hand washing after using the latrine which in turn exposes children to diarrhea. The district has the lowest / least immunisation coverage both provincially and nationally thereby exposing children to diarrhea hence the need to design strategies that improve immunisation coverages.

Ferrer et al (2008), conducted a case control study in the city of Salvador, north-eastern Brazil from November 2002 to August 2004.The purpose of the study was to

identify factors associated with diarrhea occurrence and upper respiratory tract infections in children in a city of a middle-income people, with high access to water and sanitation. The study revealed that socioeconomic factors contributed most to determining diarrhea occurrence, followed by interpersonal contact, while factors related to food preparation, the environment and water and sanitation made a smaller contribution. Zimbabwe has high unemployment rate, even Marondera district too resulting in low socio-economic status of most population exposing children to diarrhea. Parents look after the under five children, once they are infected, they expose their children to diarrhea too. Worse environment with no toilets / sanitation and no water supply.

2.5 Factors that reduce diarrhea

Diarrhea mortality reductions can be attributed to general improvements in living conditions. These comprises of better nutritional situations including exclusive breastfeeding, access to medical care, increased rotavirus vaccine coverage, increased coverage of potable water and sewerage systems and the growing use of oral rehydration therapy (Crews, et al., 2015) (Molbak, K, 2000). Persons with underlying immune suppress and those living in non-hygienic environments with exposure to contaminated water or foods, trigger repeated outbreaks as the case in Bulawayo. This is true, but becomes debatable as most communities are still struggling to earn a living, poor nutritional status, shortage of drugs in big hospitals, some districts have low vaccine coverages, water shortages due to frequent/ erratic power cuts and burst sewage systems which expose people to diarrhea.

2.6 Clinical Features of Diarrhea

Clinical features sometimes provide a clue to the cause of diarrhea according to the research the author conducted. At times this can be mistaken as malnutrition, intestinal obstruction or appendicitis hence the need of a thorough physical examination, ultra sound scan and abdominal X-rays will deduce the reality. Other

authors deduced that diarrhea caused by small intestine disease is typical high volume, watery, and often associated with malabsorption (Gasparinho, et al., 2016). The most severe threat posed by diarrhea is dehydration which can be severe and frequent, maybe accompanied by fever, sunken eyes, lethargy / unconsciousness, convulsions, unable to drink / feed or drinks poorly, restless and irritable (Anteneh, Andargie, & Tarekegn, 2017). Diarrhea caused by colonic involvement is more associated with frequent small volume stools, the presence of blood in stool (dysentery), a sensation of urgency and acute rice watery diarrhea is cholera (Wang, Zhan, & Liu, 2021).

Factors that contribute to diarrhea outbreak include travel history, sources of water (e.g. well water), recent food intake, clinical signs and symptoms are history of profuse diarrheal episodes, dehydration, fever, nausea, vomiting and abdominal pain (Green & Kreuter, 2005). Other clinical features include abrupt versus gradual onset of symptoms, symptom duration, including bowel movement frequency, stool quantities, dysentery with fever, signs of volume depletion, including thirst, tachycardia, decreased urine output, loss of skin turgor, and lethargy or confusion, or both (Thiam, et al., 2019).

Epidemiologic risk factors should be investigated for certain diarrheal diseases and their spread (Thiam, et al., 2019). They include recent travel to an area with diarrhea outbreaks, day-care Centre exposure, consumption of for example unpasteurized milk products, or a history of other ill people in a shared accommodation (Ramirez, et al., 2020). The history should include place of residence, drinking water (treated city water or well water), rural conditions, with consumption of raw milk (Sultana, et al., 2021).

Faecal testing should be performed in patients with a history of diarrhea longer than 1 day who have the following symptoms: fever, bloody stools, systemic illness,

recent or remote antibiotic treatment, hospital admission, or signs of dehydration, as described earlier (Chang, et al., 2017).

A Case Control study to assess risk factors for the transmission of diarrhea among children aged 4–59 months was done in Malaysia by Knight et al, 1992. In this study 98 pairs of children, matched on age and sex, were recruited prospectively from health canters. Exposure status was determined during a home visit. Odds ratios were measured through matched pair analysis and conditional logistic regression obtained (Knight, et al., 1992). Risk factors for diarrhea identified were: reported drinking of unboiled water, storage of cooked food before consumption and bottle feeding; and observations animals inside the house and absence of washing water in latrines (Pradhan, et al., 2021). Water quality, source of drinking water, and hand washing, indiscriminate defecation by children, cup use and the absence of a functional latrine were not associated with diarrhea. According to this study no significant associations were found for: accessibility of washing water source, type of water storage container and use of fly covers for food (Babalola, et al., 2018).

2.7 Factors that are contributing to diarrhea

The researcher subdivided the factors that contribute to diarrhea as common diarrhea l pathogen and those that are found in Zimbabwe.

2.7.1 Common diarrhea l pathogen

A cohort study of 1,314 children from Guinea -Bissau was done by Molbak et al (1990) to determine risk factors for diarrhea. Weekly diarrhea recall interviews were done between April 1987 and March 1990. Feeding practices measles infection data were available for all the children and, for 531 children, comprehensive data on explanatory variables were recorded (Molbak, K, 2000). Several studies have been done to investigate risk factors for childhood diarrhea which is a major cause of mortality among children in less developed countries (Cairncross, Hunt, Boisson, Bostoen, & Curtis, 2010). This study addressed domestic and environmental factors,

including water and sanitation, or factors related to the caregiver's hygienic practices and knowledge. The impact of feeding practices, particularly weaning practices and breastfeeding were also addressed (Molbak, et al., 1994).

A study was done in Mozambique by Mandomando et al (2000) to assess the aetiology of diarrhea in under five children who were admitted in a rural hospital in Southern Mozambique. The study was conducted between for a year from September 2000 to September 2001. Stool specimen was taken from 1 out of 11 revealed that socioeconomic factors contributed most to determining diarrhea occurrence, followed by interpersonal contact, while factors related to food preparation, the environment and water and sanitation made a smaller contribution (Knee, et al., 2018).

The study recommended that diarrhea control strategies in middle-income countries must give greater emphasis to policies geared towards reducing person transmission for the prevention of diarrhea infection were available for all children and, for 531 children, comprehensive data on explanatory variables were recorded (Ferrer, et al., 2008). Several studies have been done to investigate risk factors for childhood diarrhea which is a major cause of mortality among children in less developed countries (Getachew, et al., 2018). These studies have addressed domestic and environmental factors, including water and sanitation, or factors related to the mother's hygienic practices and knowledge (Ferrer, et al., 2008). Zimbabwe also experiences erratic water supplies and sanitation challenges- burst sewage pipes, thereby exposing major cities to repeated diarrhea l outbreaks. The problems of feeding practices, particularly weaning practices and breastfeeding were also addressed. Diarrhea causes malnutrition, affecting growth and development of the children, worse with these economic hardships faced in developing countries (Ferrer, et al., 2008).

The most common isolated diarrheagenic pathogens include Escherichia coli, Rotavirus, Salmonella (Storeng, 2014). Data on the aetiology of diarrhea are important information to use while planning and implementing control strategies to reduce diarrhea causing childhood morbidity and mortality in a country. Despite this fact, in most developing countries and especially in rural areas, no data are available on diarrhea -causing pathogens. Mozambique is not an exception, with no data currently available on the aetiology of infectious diarrhea in its rural areas (Knee, et al., 2018).

The findings were in contradiction with a previous study carried out in Maputo city, where rotavirus antigen was detected in 18.2% of all symptomatic children and in 5% of asymptomatic ones, a low prevalence of 0.6 was found in this study. The low prevalence obtained in this study could be related to explanations that in Manica area, there was a high prevalence of non-A rotavirus groups that were not detected because of experimental limitations (Wang, Zhan, & Liu, 2021). Another possibility would be that cases of rotavirus infections were not severe or had a short duration and thus did not require hospitalization (Acacio, et al., 2019). The study mentioned that to determine the real rotavirus prevalence in Manica, as well as in other regions of Mozambique, longer studies with adequate methodology were needed, hence the gap (Knee, et al., 2018).

In 2006, Botswana reported an increase in infant diarrhea and mortality (Kasule, Sebunya, Gashe, Armah, & Steele, 2003). During the first quarter of that year, twelve districts had 22 500 cases of diarrhea and 21 deaths for the entire country in the first quarter of 2005. Investigations were done and revealed that there was widespread water contamination in the four (4) northern districts of the country (Hayamo, Alemayehu, Tadesse, Mitiku, & Bedawi, 2021). The public water supply was contaminated in 26 villages tested. One of the identified causal pathogens was entero- pathogenic E- coli (classic ‘bottle diarrhea’). Some of the identified risk

factors associated with the diarrhea were socio economic status, age and mother's HIV status that were associated with children with diarrhea presenting for acute hospital care, such as caregivers not washing their hands (2.5 Adjusted Odd Ratio (AOR) (95% CI 1.1-5.0), standing water near home (AOR 2.6 (1.1-6.3), overflowing latrines (AOR 3.0 (1.1- 8.6), storing drinking water (AOR 3.7 (1.5-9.1) (Ramirez, et al., 2020).

However, the most significant risk factor was not breastfeeding (AOR 50 (95% CI 4.5-100). A closer examination of 154 children hospitalized for diarrhea was done by CDC. Most of the children were under 2 years, median age 9 months (Kamath, Shetty, Unnikrishnan, Kaushik, & Rai, 2018). The findings revealed that the majority of the children (93%) were not breastfed. About 21% of the children admitted died (32/154). Risk factors for death included not being breastfed (OR 8.5, p = 0.04) and kwashiorkor (OR 2.6, p = 0.03). Some of the infant deaths occurred outside the health facilities. The study recommended that it is essential to ensure formula-fed infants have enough formula and safe water. There is also a need to improve training for health staff and mothers in nutrition and management of diarrhea (Mero, et al., 2021). This also called for a study of the impact of point of use water treatment, safe water vessels, soap and hand washing to hospitalized children below five years presenting with diarrhea.

Data on the aetiology of diarrhea are important information to use while planning and implementing control strategies to reduce diarrhea causing childhood morbidity and mortality in a country (Gasparinho, et al., 2016). Despite this fact, in most developing countries and especially in rural areas, no data is / are available on diarrhea -causing pathogens. Mozambique is not an exception, with no data currently available on the aetiology of infectious diarrhea in its rural areas (Knee, et al., 2018).

However, breastfeeding was not the most significant risk factor (AOR 50 (95% CI 4.5-100). A closer examination of 154 children hospitalized for diarrhea was done by

CDC. Most of the children were below 24 months, median age was 9 months (Munos, Walker, & Black, 2010). The findings revealed that the majority of the children (93%) were not breastfed (Ganguly, Sharma, & Bunker, 2015) (Wu, et al., 2021).

A cohort study was done by Moy et al, 1990 to assess risk factors for high diarrhea frequency among young children living in rural Zimbabwe. The study was done over a period of twenty-two months. The risk factors assessed included feeding, environmental, educational and socio-economic factors (Moy, de C, Choto, McNeish, & Booth, 1994). The study, found no association between diarrheal morbidity and any of these factors suggesting that other factors such as individual susceptibility to diarrhea may play an important role in determining observed differences in diarrhea rates in this community (Wardlaw, Salama, Brocklehurst, Chopra, & Mason, 2010).

In 1996 a cholera epidemic occurred in the city of Kano in Nigeria. An unmatched case control study to determine the risk factors associated with the outbreak was done. A total of 5600 cases and 340 deaths were reported (Takele, Zewotir, & Ndanguza, 2019). The main risk factors identified were not washing hands with soap before meals OR 2.8 CI (1.4 – 6.0), drinking local drinks sold by street vendors OR1.1 CI (0.5 – 2.2) and eating salad OR 1.7 CI (0.8 – 3.8). Many prosperous buyers touch vender's food and thereby contaminate it and the next so on, thereby infecting them, this creates another research gap area (Gasparinho, et al., 2016).

2.7.2 Diarrhea in Zimbabwe

The director of disease control for the Ministry of Health and Child Care, Doctor Portia Manangazira reported that Zimbabwean children were dying from diarrhea outbreak. The report mentioned that seven (7) children were killed from sudden onset of diarrhea. A total of 6,500 cases were reported in the Kadoma and Masvingo outbreak with 60% of these being children under the age of five years (Maponga, et

al., 2013). The unhealthy conditions were due to poor garbage disposal and unclean water. Zimbabwean health administration was reported to have taken action in providing sewage system and clean water supply. It was also mentioned that Zimbabwean city councils has failed to concentrate on the problem that they have. The director teamed with Lever Brothers and other partners to promote good hand washing nationwide to prevent the spread of diseases. In another report in the Sunday Mail, 10/10/2011, the same director reported that a total of 101 072 cases of diarrhea had been reported country wide during the first half of the year and again 60% of these cases were children below the age of five years. The director mentioned that children are the most affected by the rotavirus. The rotavirus in children affects the mucous membrane of the small or large intestines causing imbalances inside the body. Hence, the need to increase rotavirus vaccine coverage in the country. The mother's hygienic practices, true, contribute to the child's exposure to diarrhea. Though the child's immunity, feeding and weaning practices also contribute to diarrhea. The few working-class mothers bottle feed their children whilst at work, thereby expose their children to diarrhea. Worse if the mother is HIV positive. Also, not hand washing with soap and water before meals and after using the toilet.

2.8 The precede- proceed conceptual framework model

This is a logical planning model with 8 phases, which was developed in the 1970s (Green et al 2005). The educational and ecological assessment, which is the third phase of the model, was used in this study

2.9 Summary

Diarrhea in children can be contributed by the child-immune system, feeding and weaning practices, teething, HIV status nutritional status, immunisation status, mother's HIV status, hygienic practices, behaviour seeking – culturally "nhova", interpersonal contact, environmental factors such as absence of a toilet, no water supply and burst sewage system to mention a few. Generally, the chapter gave an

overview of the contributing factors, risk factors associated with diarrhea and factors that reduce diarrhea in relation to the research project.

CHAPTER 3 METHODOLOGY

3.0 Introduction

This chapter looked at the research design, rational for selection, sampling procedures, data collection instruments, data collection procedures, pre-testing and ethical considerations.

3.1 Research Design

A matched case control 1:1 (One case is to one control) study was done, because it is efficient, useful in diseases with long latency period between exposure and disease manifestation. More so it is less costly, less time consuming, advantageous when exposure data was expensive / hard to obtain, it allowed retrospective assessment, to estimate relative risk, it actually identified risk factors associated with a disease and eliminated confounding too

3.2 Study Area

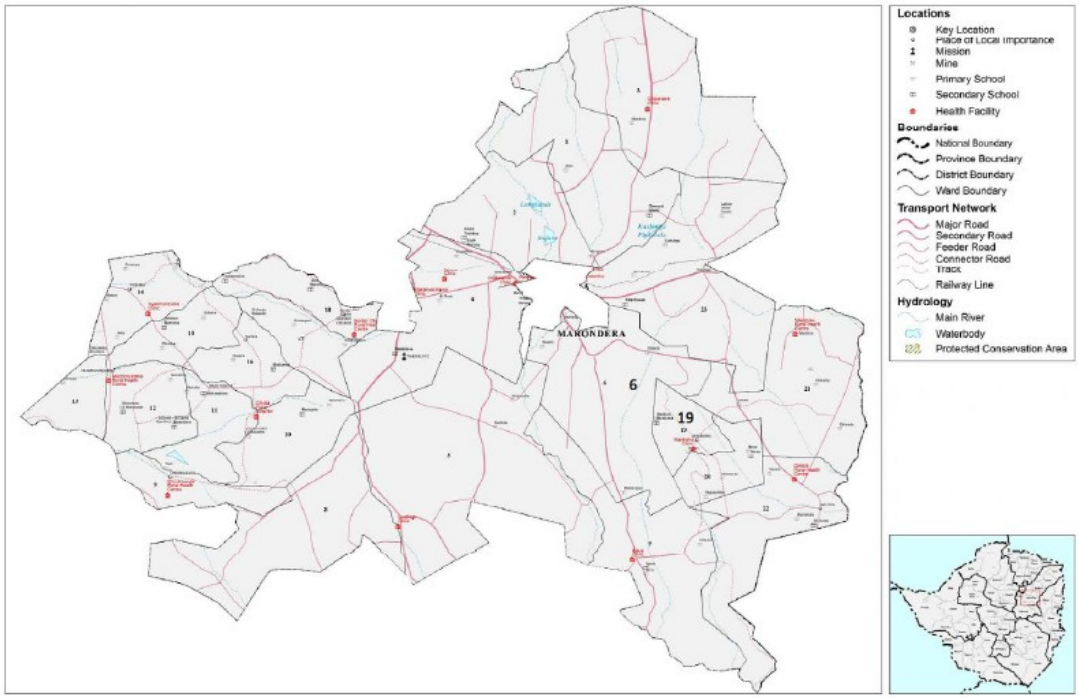

Figure 6: Marondera district map

The study was carried out at Marondera Municipal Council suburbs clinics Dombotombo, Nyameni, Nyembanzvere and Marondera Provincial Hospital,

because that was where the highest diarrhea l cases were seen and some referred to the provincial hospital.

3.3 Target Population

Children under five (5 years) from the affected surburbs of Dombotombo, Nyameni and Nyembanzvere areas were enrolled into the study in relation to total number of cases picked in proportion to health facility line list.

A case was defined as any child under the age of five who resides in one of 3 suburbs or areas of Dombotombo, Nyameni and Nyembanzvere who presented with a history of passing 3 or more loose stools in a 24-hour period with or without vomiting as from 1/1/21 to 28/2/21.

A control was defined as any child under the age of five who resides in one of the 3 suburbs or areas who did not present with diarrhea during the same period.

3.3.1 Inclusion Criteria

Children under the age of 5 years, residing in Marondera - Dombotombo, Nyameni and Nyembanzvere areas, who presented with diarrhea and those who did not have diarrhea, registered in medical records (T12 or line list) as from 1/1/21 to 28/2/21 were enrolled into the study.

3.3.2 Exclusion Criteria

- Children above the age of five.
- Children not living in Marondera District.

3.4 Sample size

The sample size was calculated using the stat calc function of EPI info 7 based on findings by Kamath et al (2018) that shaking hands at a funeral was associated with suffering from Cholera. Using 95% confidence interval assuming 50% exposure to drinking contaminated water among controls, 10% refusal rate and power of 80% the sample size of 35 cases and 35 controls was obtained. Cases were obtained from the

line list at health facilities. Using the following formula, a sample size of 70 participants was determined.

$$n = \frac{z^2 p(1-p)}{d^2}$$

Where n= sample size

P= prevalence of diarrhea in the province = 15.1%

d= margin of error (12% = 0.12)

z= 1.96 z-score equivalent to 95% confidence level

The calculated minimum sample size was 35 cases and 35 controls. We anticipated a non-response rate of 20% and the maximum sample size was 44 cases and 44 controls.

3.5 Sampling Techniques

A systematic random sampling method was used in the selection of participants from the line list obtained from MOH which had 210 cases. The line list was used as a sampling frame. The sampling interval was obtained by dividing the total number of cases on the line list with the sample size (210/44 = 4.8 approx. 5). The cases were arranged by date of attending the facilities and by alphabetic order for the day. The first case was randomly selected by rolling a die and the number that appeared on top was selected. In this study the die gave the number 4. Subsequent cases for the study were obtained by adding the sampling interval (5) to the previous number until the sample size of 44 was reached. The mothers / caregivers of the cases were interviewed. Controls were obtained from children under five years who presented at the health facilities without diarrhea and were coming from the same catchment area as the cases. Children under five who were admitted but not suffering from diarrhea were also included as controls. The mothers / caregivers of the controls were also interviewed.

An interviewer administered questionnaire was used to collect data from the mothers / caregivers. The information included socio-demographic characteristics and risk factors. The questionnaire was used due to its high response rate, fewer incomplete responses, fewer inappropriate response although it is generally expensive and time consuming. The medical records, that is, the OPD cards were checked to confirm their self - report on diarrhea and the T12 register was checked as well to confirm eligibility of the diarrhea cases.

3.6 Research Instruments

To collect primary data, the interviewer administered structured questionnaire through one-on-one interviews was used. The questionnaire had 3 sections which ranged from socio-demographics, signs and symptoms and habits/ practices to environmental factors. Some of the questions were adopted from Zimbabwe Demographic Health Survey questions. The questionnaire was suitable for this study because of limited resources and also high response rate. To collect secondary data, a data abstraction form was used to record data from desk review of medical records (OPD cards) to ascertain / confirm self-report of diarrhea. Also, T12 Registers were checked to confirm eligibility of the case as well as the line list.

3.6.1 Pretesting of data collection tools

The questionnaire was pretested at Mahusekwa District Hospital in order to measure the reliability and validity of the research tools. This was done using a sample of 20 participants. Issues identified in terms of flow of the questions, validity and reliability were rectified after pre-test.

3.7 Data collection Techniques

Permission to carry out the study was sought from PMD Mashonaland East and DMO Marondera district. Permission was also obtained from mothers / caregivers of

the cases and the controls. Those who were picked from the line list were interviewed in one of the offices provided by the facility. In the case of the case refusing, the next case in the line list was selected and the sampling interval added to get the next case. Mothers of the controls coming from the same area as the cases were selected to participate in the study. Codes were used in place of actual names of participants. Confidentiality and privacy were ensured and feedback from study results was ensured. All completely filled in questionnaires were stored in cupboard accessible to the researcher and her supervisors. The medical records (the OPD cards) were also checked to confirm their self - report on diarrhea and Registers especially T12 register was checked as well to confirm eligibility of the diarrhea cases. The data was recorded on the data abstraction form.

3.8 Data management

All the questionnaires were numbered from 1to 70 and checked for completeness. The data was then coded and entered into excel spreadsheet. The spreadsheet was then imported into SPSS and STATA packages. Data cleaning and cleansing was done before univariate, bivariate and multivariate analysis to establish the factors associated with diarrhea outbreak in Marondera district. Data presentation was done using descriptive statistics, tables, pie charts, graphs and histograms.

3.9 Ethical considerations

No names or addresses were used. Informed written consent was sought from all the participants. The participants were interviewed privately such that no information was disclosed to any persons other than those relevant to the study. This was done to ensure that privacy and confidentiality was maintained throughout.

3.9.1 Clearance

Clearance to conduct the study was sought from the District Medical Officer, Provincial Medical Director, local authority as well as from the parents / caregivers themselves too and AUREC.

3.9.2 Informed Consent

The study procedure was explained in full to all study participants in the local language (Shona), so that they could understand. Written informed consent was obtained from study participants who were able to read and write whilst those who could not write used their thumb (dipped in ink) to sign.

3.9.3 Confidentiality

Participants' information that was availed to the researcher was not / never divulged to anybody else other than the supervisor of this study. In addition, participants' names were not included on the questionnaires. Completed questionnaires and signed consent forms were locked and kept in a secure cabinet. All this was done to maintain the confidentiality of the study participants at all stages of the study.

3.9.4 Principle of Justice and No Harm

All participants were treated fairly and not subjected to any harm.

3.10 Summary

A case control study design involving 70 participants systematically selected was done in Marondera district to determine risk factors associated with contracting diarrhea in children under 5 years. This design was simple, easy to execute once a sampling frame was drafted and it reduced selection biases.

CHAPTER 4 DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.0 Introduction

This chapter covered the findings / results, analysis and presentation on tables, graphs, pie chart and measures of association.

4.1 Summary of participants demographics

35 cases and 35 controls were enrolled into the study. A questionnaire was administered to all of them. The mean age in months for the study subjects was 26.3 months with a standard deviation of 17.5. The study participants comprised of 51.4% (n = 18) male cases and 48.6% (n= 17) female cases. The mean household number for all participants was 5with a standard deviation of 2. A total of 475 cases were seen at the clinics during the outbreak from Table 1.1. Table 4.1 shows the social, economic and demographic characteristics analysed in Marondera District.

Table 3: Distribution of participants by Socio-economic and demographic characteristics in Marondera District

Variables	Response category	Cases (N=35) n	%	Controls (N=35) n	%
Sex of child	Male	18	51.4	16	45.7
	Female	17	48.6	19	54.3
Age of child in months	0-5	0	0,0	0	0.0
	6-11	4	11.4	0	0.0
	12-23	16	45.7	21	60
	24-35	10	28.6	11	31.4
	35-60	5	14.3	3	8.6
Number of people in household	≤4	6	17.1	20	57.1
	>4	29	82.9	15	42.9
Number of children <5	One	3	8.6	25	71.4
	Two and above	32	91.4	10	28.6
Occupation of mother / caregiver	Housewife	11	31.4	15	42.9
	Civil servant	8	22.9	10	28.6
	Vendors	9	25.7	6	17.1
	Others	7	20	4	11.4
Monthly income (US$)	<50	18	51.4	9	25.7
	50-100	9	25.7	15	42.9
	>100	2	5.7	8	22.9
	I don't know	6	17.1	3	8.6
Immunization status	Up to date Yes	31	88.6	35	100
	No	4	11.4	0	0.0

Table 4: Distribution of cases by Age and level of education

Variable	Cases (N=35)		Controls (N=35)	
	n	%	n	%
Age				
Mean	26.6		25.9	
Sd	19.4		15.5	
Level of education				
None	7	20.0	3	8.6
Primary	9	25.7	9	25.7
Secondary	19	54.3	22	62.9
Tertiary	0	0.0	1	2.9
Facility -Dombotombo	10	28.6	10	28.6
Nyameni	10	28.6	10	28.6
Nyembanzvere	10	28,6	10	28,6
Marondera Prov Hospital	5	14,3	5	14,3

Chi-square=2.819, df = 4, p=0.42. There was no statistically significant association between the level of education and developing diarrhea. Most of the cases (n=19, 54.3%) and controls (n=22, 62.9%) had attained secondary level education while none (0) of the cases and only one (1) control had tertiary level education.

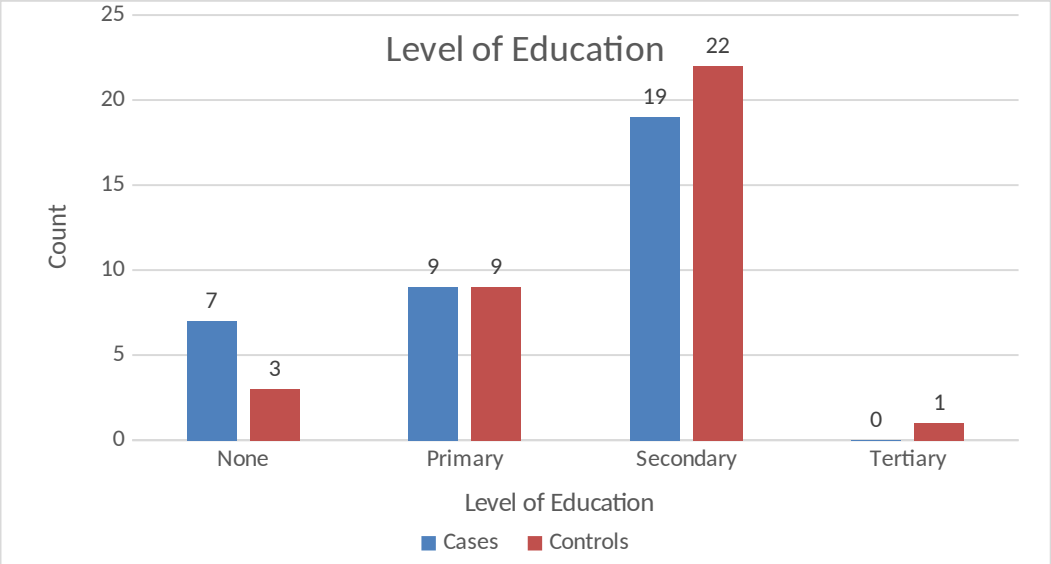

Figure 7: Graphical presentation of the level of education of cases and controls

4.3 Socio-demographic factors of parents / caregivers associated with diarrhea in Marondera District in 2021

The socio-demographic factors in Marondera District which are associated with diarrhea are analyzed in this section.

Table 5: Summary of socio-demographic factors in Marondera District

Variable	Cases (N=35) n (%)	Controls (N=35) n (%)	ODDS Ratio	95%CI	p-value
Sex					
Male	18(51.4)	16(45.7)	1.26	0.49-3.22	0.632
Female	17(48.6)	19(54.3)			
Age					
0-5	0(0,0)	0(0,0)			
6-11	4(11,4)	0(0,0)			
12-23	16(45.7)	21960.0)	0.46	0.09-2.20	0.322
24-35	10(28.6)	11(31.4)	0.55	0.10-2.89	0.474
35-60	5(14.3)	3(8.6)		Ref	
Level of Education					
None	7(20.0)	3(8.6)	Ref		
Primary	9(25.7)	9(25.7)	0.43	0.08-2.20	0.434F
Secondary	19(54.3)	22(62.9)	0.37	0.08-1.63	0.291F
Tertiary	0(0.0)	1(2.8)			
Monthly income					
<50	18(51.4)	9(25.7)	Ref		
50-100	9(25.7)	15(42.9)	0.30	0.10-0.95	0.037*
>100	2(5.7)	8(22.9)	0.13	0.02-0.72	0.023*
I don't know	6(1.7)	3(8.5)	1.00	0.20-4.95	1.000
Occupation of caregiver					
Housewife	11(31.4)	15(42.9)	Ref		
Civil servant	8(22.9)	10(28.6)	1.09	0.32-3.67	0.888
Vendors	9(25.7)	6(17.1)	2.05	0.56-7.45	0.275
Others	7(20.0)	4(11.4)	2.39	0.56-10.22	0.295
Number of people in household					
≤4	6(17.1)	20(57.1)	Ref		
>4	29(82.9)	15(42.9)	6.44	2.13-9.46	0.0005*
Religion					
Apostolic	6(17.1)	6 (17.1)	1.13	0.302-4.198	0.861
Pentecostal	4(11.4)	10(28.6)	0.45	0.118-1.720	0.338
Traditional	9(25.7)	1(2.9)	10.13	1.153-8.945	0.027*
Others	16(45.7)	18(51.4)	Ref		

* Means significant

Male children under the age of 5 in Marondera district had 1.26 increased odds of developing diarrhea compared to their female counterparts although it was not statistically significant [OR=1.26, 95%CI= (0.49-3.22), p=0.632]. The study found

no statistically significant relationship between level of education of mother / caregiver and development of diarrhea. Children who had mothers/caregivers with primary or secondary level education were 57% and 63% respectively less likely to develop diarrhea compared to those with no education [OR=0.43, 95%CI = (0.08-2.20), p=0.434 and OR=0.37, 95%CI = (0.08-1.63), p=0.291]. However, there was a statistically significant relationship between Monthly Income and development of diarrhea wit families earning between USD (50 -100) and those getting at least USD100 being 70% and 87% less likely to develop diarrhea respectively compared to those earning less than USD50 [OR=0.30, 95%CI = (0.10-0.95), p=0.037 and OR=0.13, 95%CI = (0.02-0.72), p=0.023]. The study also found a strong and significant relationship between number of people in a household and developing diarrhea with households with more than 4 members having 6.44 increased odds of developing diarrhea compared to those in households with less than or equal to 4 members.

There was no clear association between getting diarrhea and religion. Chi-square value = 0.46, df = 3 and it was marginally significant (p= 0.499). However, individually none of the options had any statistical significance as a risk factor in causing diarrhea except for Traditional believers. Apostolic were 13% more likely to develop diarrhea compared to those of other denominations although it was not statistically significant [0R=1.13, 95%CI= (0.302-4.198), p=0.861]. Participants of the Pentecostal denomination were 55% less likely to develop diarrhea compared to those of other denominations although it was not statistically significant [OR=0.45, 95%CI= (0.118-1.720), p=0.338]. However, participants of the traditional denomination had 10.13 increased odds of developing diarrhea compared to those of other denominations and it was statistically significant [OR=10.13, 05%CI = (1.153-8.945), p=0.027].

4.3.1 Other risk factors associated with diarrhea

In terms of environmental characteristics (Table 6, 7 and 8), cases were 0.65 times more likely to develop diarrhea compared to controls when using mud floors.

Table 6: Environmental characteristics of the study households Marondera

Variables	**Cases (N=35) n**	**%**	**Control (N=35) n**	**%**	OR (95%CI)	p-value
Housing floor material						
Mud	32	91.4	35	100.0		
Wood	1	2.9	0	0.0	Undefined	
Cement	2	5.7	0	0.0	Undefined	
Daily water consumption (in litres)						
< 20	1	2.9	0	0.0		
20 – 30	29	82.9	34		0.17(0.019-1.545)	0.106F
>30	5	14.3	1	2.9	Ref	
Type of latrine						
Simple pit latrine	9	25.7	9	25.7	Ref	
Ventilated improved pit latrine	17	48.6	20	57.1	0.85(0.275-2.625)	0.778
Pour-flush latrine	3	8.6	4	11.4	0.75(0.129-4.356)	0.748
Latrine ownership						
No latrine	6	17.1	2	5.7	Ref	
Privately owned	5	14.3	1	2.9	1.67(0.115-24.25)	1.000F
Shared	24	68.6	32	91.4	0.25(0.046-1.349)	0.132F
Latrine pit-hole cover						
Yes	1	2.9	0	0	Undefined	
No	34	97.1	35	100		
Faeces seen around the pit hole/slab/floor of latrine						
Yes	14	40	10	28.6	1.67(0.615-4.520)	0.313
No	21	60	25	71.4		
Waste disposal method						
Pit/Burning	13	37.	10	28.6	1.08(0.371-	0.884

		1			3.165)	
Garbage bin	4	11.4	10	28.6	0.33(0.09-1.282)	0.123
Open field	18	51.4	15	42.9	Ref	

There were no environmental factors that were found to be statistically significantly associated with development of diarrhea in children under 5 years of age in Marondera district.

4.3.2 Illness Presentation and outcome

All cases (n=35) presented with watery diarrhea and 62.9% (n=22) of them had cramps in the abdomen and 14(40.0%) of them had fever.

Table 7: Presenting symptoms in the cases

Variable	Cases (N=35)	%
Watery diarrhea	35	100.0
Fever	14	40.0
Cramps in the abdomen	22	62.9

All the cases (n=35) received ORS and the majority (n=23, 65.7%) improved. The following table shows the outcome of the illness after treatment. There were no deaths recorded during the outbreak.

Table 8: Outcome of the diarrhea

Variable	Cases (N=35)	%
Got better	23	65.7
Got worse	3	8.6
No change	6	17.1
Just started treatment	3	8.6

Table 9: Water supply analysis

Variable	Cases (N=35)		Controls (N=35)			
	n	%	n	%	OR (95%CI)	p-value
Source of drinking water in the past week						
Tap	29	82.9	35	100		
Open well	6	17.1	0	0.0		
Water cut in the past week						
Daily	21	60.0	4	11.4	Ref	
Less than 3 days	7	20.0	14	40.0	0.10(0.023-0.387)	0.0007*
At least 4 days but less than 1 week	5	14.3	1	2.9	0.95(0.087-10.484)	1.000
Not at all	2	5.7	16	45.7	0.02(0.004-0.147)	0.00002*
Sources of water if water is cut						
Open wells	18	51.4	4	11.4	Ref	
Neighbours	10	28.6	5	14.3	0.44(0.097-2.043)	0.438
Put in container	7	20	26	73.3	0.06(0.015-0.235)	0.00002*
Sources of washing water						
Tap	8	22.9	31	88.6	Ref	
Open wells	21	60	3	8.6	27.13(6.440-114.2	<0.001*
Containers	6	17.1	1	2.9	23.25(2.438-221.7)	0.0019*

* Means significant

Water supply has been a crisis in the district causing many health risks. The study did not establish an association between diarrhea and source of drinking water the OR was undefined. None of the controls admitted to drinking open well water in the past week. Having water cuts less than 3 days in the past week had 90% reduced odds of developing diarrhea compared to those who had water cuts daily and it was statistically significant [OR=0.10, 95%CI = (0.023-0.387), p=0007]. Having no water cuts in the past week had statistically significant protective effect (98%) from getting diarrhea compared to those who had daily water cuts [OR=0.02, 95%CI= (0.004-0.147), p=0.00002]. During the period when there were water cuts some got water from open wells, neighbours and some used containers. Those who got water from neighbours were 56% less likely to develop diarrhea compared to those who used open well although it was not statistically significant [OR=0.44, 95%CI =

(0.097-2.043), p=0438]. Those who used water stored in containers had 94% reduced odds of developing diarrhea compared those who used open wells and it was statistically significant [OR=0.06, 95%CI = (0.015-0.235), p=0.00002]. Using open wells water for washing clothes was strongly associated with developing diarrhea. The study established that using open wells water for washing increased the odds of developing diarrhea by 27.13 times compared to those using tap water and it was significant [OR=27.13, 95%CI = (6.440-114.2, p<0.001]. Using container water for washing was statistically significantly associated developing diarrhea in Marondera district with those using the container water for washing having 23.25 increased odds of developing diarrhea compared to those using tap water [OR=23.25, 95%CI = (2.438-221.7), p=0.0019]

Table 10: Sources of bathing water

Variable	**Cases (N=35) n (%)**	**Controls (N=35) n (%)**	**OR (95%CI)**	**p-value**
Sources of bathing water				
Tap	8(22.9)	33(91.4)	Ref	
Open wells	19(54.3)	2(8.6)	39.19(7.533-203.9)	<0.0001F*
Containers	8(22.8)	0(0.0)		
Water storage				
Open container	25(71.4)	8(22.9)	8.44(2.873-24.7775)	0.00005*
Closed container	10(28.6)	27(77.1)	Ref	
Water retrieval from container				
Cup with handle	22(62.9)	8(22.9)	6.19(2.150-17.806)	0.00046*
Cup with no handle	1(2.9)	0(0.0)		
Pour from container	12(34.3)	27(77.1)	Ref	

* Means significant F = Fisher Exact

Open wells water for bathing statistically significantly increased the odds of developing diarrhea by 39.19 times compared to those who used tap water [OR=39.19, 95%CI= (7.533-203.9), p<0001F]. Storing water in open containers was strongly associated with the development of diarrhea in Marondera district with those storing water in open containers being 8.44 times more likely to develop diarrhea compared to those storing in closed containers [OR=8.44, 95%CI= (2.873-24.7775),

p=0.00005]. Retrieving water from the container using a cup with a handle was statistically significantly associated with the development of diarrhea in Marondera district [OR=6.19, 95%CI = (2.150-17.806), p=0.00046]

Table 11: Burst sewer pipes within 50M radius

Variable	**Cases (N=35)**		**Controls (N=35)**			
	n	%	n	%	OR (95%CI)	**p-value**
Yes	31	88.6	8	22.9	26.16(7.083- 96.596)	<0.000001
No	4	11.4	27	77.1		

Having burst sewer pipes within a radius of 50 metres was found to be a risk factor for contracting diarrhea l infection in Marondera district with those experiencing sewer pipe bursts having 26.16 increased odds of developing diarrhea compared to those who did not [OR =26.12, 95%CI = (7.01-96.6), p<0.000001]

4.5 Knowledge, habits and practices of parents / caregivers of under-fives in Marondera district.

In this section results we focus on the knowledge of the caregivers, how they wash their hands after relieving themselves, how they treat their water and their perceptions on diarrhea contacts at home.

Table 12: Knowledge levels of mothers/caregivers of under 5s in Marondera district

	Cases (N=35)		Controls (N=35)			
Variable	**n**	**%**	**n**	**%**	**OR (95%CI)**	**p-value**
What is done to your drinking water?						
Boil	4	11.4	15	42.9	0.13(0.036-0.460)	0.0010F*
Put Sodium Hypochlorite	2	5.7	6	17.1	0.16(0.029-0.901)	0.0447*
Nothing	29	82.9	14	40.0	Ref	
How often do you wash your hands after using the toilet?						
Not at all	4	11.4	2	5.7	3.2(0.492-20.810)	0.365F
Always	10	28.6	16	45.7	Ref	
Sometimes	21	60.0	17	48.6	1.04(0.414-2.617)	0.933
Diarrhea contact at home						
Yes	17	48.6	11	31.4	2.06(0.778-5.458)	0.1432
No	18	51.4	24	68.6		
Diarrhea contact outside home						
Yes	5	14.3	2	5.7	2.75(0.496-15.247)	0.4282F
No	30	85.7	33	94.3		
Washing of hands before a meal						
Communal dish	11	31.4	6	17.1	2.22(0.714-6.873)	0.1634
Drip to waste	24	68.6	29	82.9		
Relieving self						
Flush toilet	30	85.7	34	97.1		
Bush	4	11.4	0	0		
Blair toilet	1	2.9	1	2.9	1.13(0.068-18.919)	1.0000
Received health education on diarrhea in past 6 months						
Yes	5	14.3	8	22.9	0.56(0.164-1.929)	0.5401
No	30	85.7	27	77.1		

* Means significant F = Fisher Exact

Only 4 (11.4%) of the cases and 15 (42.9%) of the controls reported boiling water before drinking. Boiling water before drinking and adding sodium hypochlorite was 87% and 84% respectively protective and statistically significant against diarrhea in Marondera district compared to those who did nothing to the water before drinking it [OR=0.13, 95%CI = (0.036-0.460), p=0.0010F] and [OR=0.16, 95%CI = (0.029-0.901), p=0.0447]. 10(28.6%) of the cases and 16(45.7%) of the controls reported that they always washed their hands after using the toilet while 60% (n=21) of the cases and 48.6 (n=16) of the controls sometimes washed their hands after using the toilet. Participants who did not wash their hands after using the toilet and those who sometimes washed their hands were 3.2 and 1,04 times more likely to develop diarrhea compared to those who always washed their hands although it was not statistically significant. Almost half (n=17, 48.6%) of the mothers/caregivers of the under 5 cases and almost a third (n=11, 31.4%) of the mothers/caregivers of under 5 controls who developed diarrhea in Marondera district reported that they someone at the home who had diarrhea. Having a diarrhea contact at home had 2.06 increased odds of developing diarrhea in Marondera district compared to those who did not a contact at home although it was not statistically significant [OR=2.06, 95%CI = (0.778-5.458), p=0.1432].

Having a diarrhea contact outside home had 2.75 increased odds of developing diarrhea in Marondera district compared to those who did not have an outside contact although it was not significant [OR=2.75, 95%CI = (0.496-15.247), p=0.4282F]. Mothers /Caregivers of under 5s who participated in the Marondera district study (n=11, 31.4%) for cases and (n=6, 17.1%) for controls reported that they used the communal dish to wash their hands before eating a meal. Participants who used the communal dish to wash their hands before eating a meal were 2.2 times more likely to contract diarrhea compared to those who used the drip to waste method although it was not statistically significant [OR=2.22, 95%CI = (0.714-6.873), p=0.1634]. The

majority of the mothers/caregivers (n=30, 85.7% cases) and all the controls except one (1) reported that they were using flush toilets and only 4 (11.4%) mothers/caregivers of the cases reported that they were using the bush system and an equal number, one (1) were using the Blair toilet to relieve themselves. There was no significant association between type of toilet used to relieve and contracting diarrhea in Marondera district [OR=1.13, 95%CI = (0.068-18.919), p=1.0000]. Also, there was no significant difference between cases and controls in terms of having received health education on diarrhea in the past 6 months [OR=0.56(0.164-1.929), p=0.5401].

Table 13: Summary of risk factors

Risk factor	OR	95%CI	p-value
Boiled water	0.01	0.05-0.60	0.00311*
Household number	7.08	0.69-17.8	0.527
Female sex	0.79	0.31-2.03	0.632
Age	3.37	0.45-8.76	0.74
Attending any gathering in past 2 weeks	1.38	0.28-6,67	0.69
Type of gathering	0.5	0.02-11,08	0,60
Eat/drink at a gathering	0	0-52	0.57
Activities at the gathering	0.67	0.024-18.06	0 81
Doing nothing to drinking water	7.25	2.39-21.97	0.0023*
No water cuts in past week	0.07	0.015-0.35	0.00013*
Daily water cuts	11.62	3,35-40.23	0.000023*
Open wells use if water is cut	8.2	2.39-28.20	0.00031*
Putting water in containers if water is cut	0.08	0.0282-0.266	0.00006*

Table 14: Measures of association of checklist risk factors

Variable	**OR**	**95%CI**	**P value**
Having running tap water	0.07	0.02-0.22	0.0025*
Water storage in closed container	0.39	0.39-0.15	0.05*
Bothering flies	4.58	1.31-15.93	0.012*
Burst sewer	17.3	5.09-10.9	0.0001*
Clean toilet	0.14	0.32-0.72	0.0021*

Please note that, none of the cases and controls had their bins collected so it was not possible to establish any association between bin collection and diarrhea l infection

in this study. Having running tap water, storing water in a closed container and having a clean toilet was protective from contracting diarrhea. Risk factors were having bothering flies in the vicinity and having burst sewer pipes within a 50 m radius.

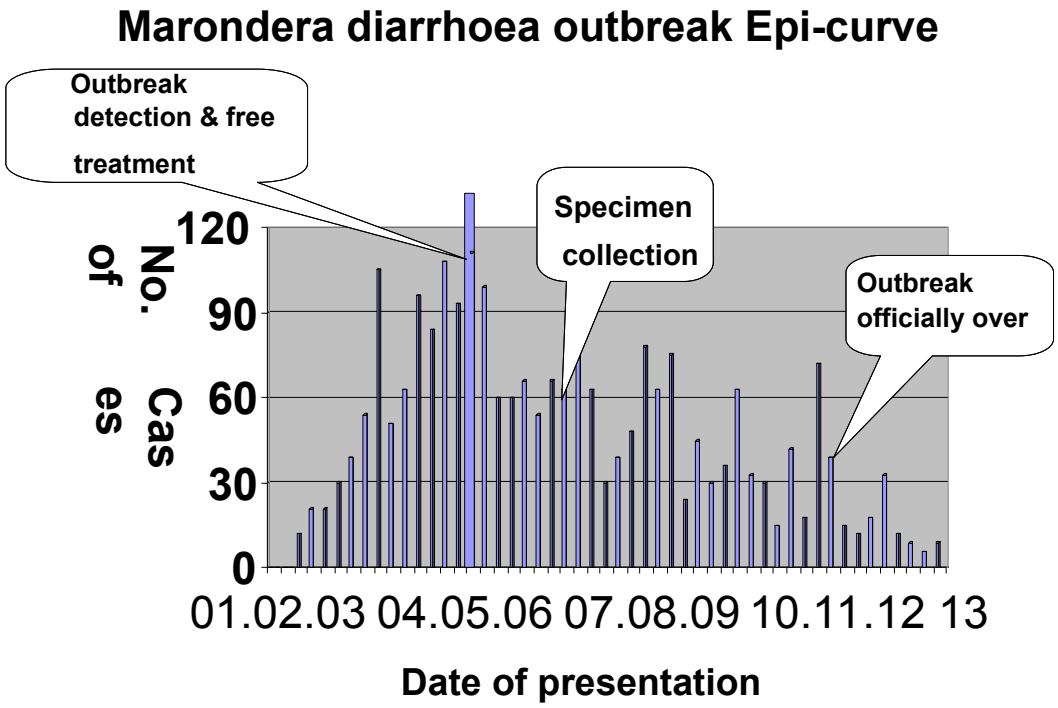

Figure 8: Diarrhea Epi-curve

4.6 Summary

Marondera district experienced daily water cuts between January and February 2021 which statistically was a significant risk factor for developing diarrhea. Also use of contaminated open well water, burst sewer pipes, bothering flies from none refuse collection and drinking none boiled or chlorinated water. Boiling water had protective effect.

Health education status of mothers and caregivers is a variable that community health nurses can manipulate to improve the survival chances of the under-5 children. Reducing under-5s mortality and morbidity in Marondera district requires sensitivity of HCWs and especially community health nurses (CHNs) to deficient knowledge about exclusive breastfeeding, personal hygiene and sanitation. The CHNs in Marondera district should therefore be sensitized through mediums such as

workshops and seminars, on the latest WHO recommendation for diarrhoea management. This approach will be cost-effective and will assist in achievement of goal 4 of the MDGs

4.4 Summarized risk factors

Having water cuts less than 3 days a week was statistically significant risk factor for causing diarrhea and having water had protective effect. Using contaminated open well water was a significant risk factor for getting diarrhea while using water stored in closed containers had protective effect. Burst sewer pipes within 50 meter radius were a risk factor for contracting diarrhea l diseases. Also none refuse collection was noticed by both cases and controls, pausing threat to getting diarrhea. Drinking none, boiled or chlorinated water was statistically significant risk factor for developing diarrhea. Boiling water before drinking it was protective.

CHAPTER 5 SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.0 Introduction

This chapter discusses the findings that were made during the survey in Marondera District during the study period.

5.1 Findings

5.1.1 Walk through survey in the Marondera suburbs and clinics

Informal vendors are a common feature selling raw meat (chicken, beef, pork, sausages and fish), milk, peanut butter, fruits, vegetables and non-perishables like cooking oil. The vendors are found even at the shopping centres. There are open dumping areas in Marondera town, locations and shops; and it is a breeding place for flies. Draining sewer pipes are a common sight in Marondera and even near the clinics too.

There are open spaces (vleis) separating the Marondera locations. Residents have resorted to creating open shallow wells where they get their water from if they experience water cuts. In most cases the people have to go inside the shallow well in order to be able to scoop enough water due to the limited amounts available inside.

5.2 Discussion

The investigation established that the infection was not a point source; instead it was a propagated infection. In this study, having running water daily was found to be having a significant protective effect against diarrhea. This concurred with a study done by (Maponga, et al., 2013). If water cuts are experienced they results in diarrhea l diseases. From the results people were getting the infection from contaminated water. From the results people were most likely getting the infection from the contaminated water. This source of infection leads to many cases as was experienced in the USA a diarrhea l outbreak resulting from contaminated non

chlorinated water involved 25 000 cases. This also concurred with (Naghavi, et al., 2017; Nhampossa, et al., 2015; Takele, Zewotir, & Ndanguza, 2019; Wang, Zhan, & Liu, 2021; Pradhan, et al., 2021).

5.2.1 Sewage / drainage situation

The environmental factors according to (Baker, et al., 2016; Cairncross, Hunt, Boisson, Bostoen, & Curtis, 2010; Knee, et al., 2018), caused diarrhea. This concurred with this study where burst sewer pipes, water and sanitation was statistically risk factors for developing diarrhea. There was water contamination and breeding of flies as well. Burst sewers are a common site in Marondera this is the most likely reason why the outbreak extended over a long period.

5.2.2 Knowledge, habits and practices

According to Wang et al (2021), non-availability of plenty of water results in people not exercising high standards of hygiene since having water cuts daily was found to be a risk factor for developing diarrhea. This concurred with the findings from this study and a lot of people end up being infected. Using open well water for drinking, washing and bathing was found to be risk factors. This kind of water is easily contaminated since it is not protected. Residents were found to be going inside the wells in order to fetch water thereby increasing the chances or contaminating the water. The possibility of feet being infested with bacteria is high since sewerage is flowing in most parts of Marondera.

Having no water cuts at all is protective due to the availability of a lot of water thereby maintaining high standards of hygiene. Putting water in closed containers was protective. This practice minimizes water contamination. Boiling water kills potential pathogens hence the protectiveness in developing diarrhea.

Hand washing habits was not associated with contracting diarrhea. Non refuse collection was found in all the cases and controls so it was not possible to assess the association with diarrhea l infection. Diarrhea l infection was not found to be precipitated by a positive contact both at home or outside home in this study possibly to the small numbers who had a diarrhea contact.

Only 17% of the respondents used chemicals to purify water. The reason for this was not explored in this study. 40% of the respondents did not do anything to their drinking water and the possible reasons are; lack of knowledge, erratic power supplies coupled with expensive firewood and fear of carcinogenicity of boiled chlorinated water as highlighted in the local media just before the outbreak.

It was interesting to note that the drugs which were being prescribed depended so much on what was in stock and also according to sensitivity test results. It is only fortunate that most of the cases got better on treatment. No deaths or complications were picked during the outbreak. Prescribing antibiotics to every case was expensive but possibly this is the reason why they were no complications. More so the treatment was free to all the children including the drugs.

5.2.3 The socio-demographic factors

There was no significant difference in the mean ages of cases and controls in this study. However, Getachew et, al (2018) claims that the child's nutritional status, immune system, HIV status and vaccination status have a protective effect against developing diarrhea.

5.3 Limitations of the study

- The student was a full-time employee in the ministry of health and child care, so she would do the project after hours, weekends and public holidays.

- Not all the District Health Executive members (DHE) for Marondera district were interviewed, due to time and busy schedules and same for the PHE members
- Only 35 cases and 35 controls were enrolled into the study due to time and financial constraints (logistics) which may hinder generalization of findings.
- The study took more than three weeks to be conducted and concluded due to busy schedules at the workplace, inter-departmental communication, power / electricity (ZESA) and network challenges.
- The study was carried out some weeks after the onset of the outbreak and the cases were being followed up after having been treated. There is a possibility of recall bias.
- We had fuel and transport challenges hampering timely transportation of specimens hence most of the specimens were negative possibly due to the delays.
- The clinics had no covering Medical Doctor, the nurses coordinated most of the activities; credit goes to the Nurse / Sister-in-charge who worked so hard together with her /his team.

5.4 Conclusion

The research was an eye opener, we managed to identify risk factors associated with contracting diarrhea in children which were water shortages due to frequent erratic power cuts, resulting in use of contaminated water from open shallow wells, non-chlorinated water, which compromised hand and personal hygiene as well as infection control standards, burst sewer pipes, non-refuse collection and open dumping areas which are now becoming breeding sites / areas for flies resulting in

water borne disease such as diarrhea. This called for urgent action by the local authorities.

5.5 Recommendations

The following are recommendations which were derived from the study.

1. Water cuts should be minimized to less than 3 days per week and residents must be informed in advance so that they can store water in closed containers for use when there are water cuts. Marondera municipality to liaise with ZINWA, and health promoters can reach the community with the right information.
2. There is urgent need to attend to the leaking sewer pipes- Marondera municipality and ZINWA and the local politicians
3. Residents should be encouraged to boil their drinking water- Health Promoters and Village health Workers to act on this.
4. Residents are digging open wells in the open vleis to get water; boreholes can be sunk in such areas to avail clean water to people. Marondera municipality, ZINWA and politicians to action.
5. Refresher training is needed on the rationale use of antibiotics in the treatment of acute gastroenteritis to the nursing staff – District Nursing Officer, District Medical Officer, Provincial Nursing Officer and Deputy Director Nursing Services.

5.6 Dissemination and Utilization of Results

Feedback of the information generated from the study was given to the District Health Executive (DHE) of Marondera District members for use in preventing and controlling diarrhea. It was envisaged that this would contribute towards reduction of morbidity and mortality amongst children under 5 years.

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7.0 APPENDICES

Appendix A: Questionnaire

My name is…PLAXEDES M UTUBUKI….. I am an MPH Student carrying out a research on risk factors associated with contracting diarrhea in children under 5 years in Marondera District for the period of January to April 2021. I would like to interview you in order to assist me with some information about the subject, if you are willing to participate in the study. I can assure you that the information you provide will be treated with privacy and confidential and will be used to make improvements in the prevention and control of diarrhea in the District.

Questionnaire no: ----

Demographic Data of caregivers

1 .Age [ ]

2. Sex Male [ ] Female [ ]

3. Marital Status Single [ ] Married [ ] Divorced [ ] Widowed [ ]

5. Level of Education None [ ] Primary [ ] Secondary [ ] Tertiary [ ]

6. Religion Traditional [ ] Pentecostal [ ] Apostolic [ ] Orthodox [ ]

7. Caregiver (mother) Yes [ ] No [ ]

If the above is No, give the name of the caregiver (other) ……..

8. How many people live in your homestead……..

9. Is your child's immunisation status up to date? Yes [ ] No [ ]

10. Signs and symptoms of Diarrhea

To answer these questions tick inside the box, either YES or NO

Sign &/ symptom		YES	NO
Does your baby show any sign of	Diarrhea		
	Vomiting		
	No dehydration		
	Mild dehydration		
	Severe dehydration		

11. Checklist of risk factors associated with contracting diarrhea

(The following table has a number of risk factors for contracting diarrhea, you can answer by ticking in the box of either YES or NO

Risk factors		**YES**	**NO**
1	Do you have a Toilet at your homestead?		
2	Do you have a good hand washing facility?		
3	Do you have a water source at your homestead?		
4	Is the water safe to drink		
5	Have you been in contact with a person suffering from Diarrhea?		
6	Did you attend any funeral recently?		
7	Did you travel anywhere in the past 2 weeks?		
8	Did you ever experience poor hygiene?		
9	Do you have any history of having a meal outside home?		
10	Have you ever used a toilet and didn't wash your hands?		
11	Do you know what Diarrhea is?		
12	Have you ever ate cold sadza?		
13	Have you ever ate cold porridge?		
14	Have you ever ate cold vegetables?		
15	Have you ever ate cold rice?		
16	Have you ever ate cold milk?		
17	Are you breastfeeding your baby?		
18	Are you taking any artificial feeds?		
19	Are you taking any mixed feeds?		

Appendix B: Questionnaire for parents / caregivers

Table 15: Demographic characteristics of Caregivers

Variable	**Cases**	**Controls**	**p-value**
Level of education			
None			
Primary			
Secondary			
Tertiary			
Religion			
Traditional			
Pentecostal			
Apostolic			
Orthodox			
Other			
Caregiver(mother)			
Other			
No of people in the household			

Table 16: Demographic characteristics of children (Cases and Controls)

	CASES	CONTROLS	P-VALUE
Sex			
Male			
Female			
Immunization status			
Up to date			
Yes			
No			

Table 17: Commom signs and Symptoms

Sign and / symptom	**Frequency**	**Percent**
- Diarrhea		
- Vomiting		

- No dehydration
- Mild dehydration
- Severe dehydration

Table 18: Risk factors for contracting diarrhea

Risk factors	Cases	Controls	OR	CI
toilet absent				
YES				
NO				
Hand washing facility absent				
YES				
NO				
Unsafe water source				
YES				
NO				
Diarrhea contact				
YES				
NO				
Attended funeral				
YES				
NO				
Travel in past 2 weeks				
YES				
NO				
Poor hygiene				
YES				
NO				
History of having a meal outside home				
YES				
NO				
Not washing hands after using toilet				
YES				
NO				
Knowledge about Diarrhea				
YES				
NO				
Ate cold sadza				
YES				
NO				
Cold porridge				
YES				
NO				
Cold vegetables				
YES				

NO
Cold rice
YES
NO
Cold milk
YES
NO
Breastfeeding
YES
NO
Artificial feeds
YES
NO
Mixed feeds
YES
NO

Appendix C: Informed consent guide

Identify yourself

My name is Mutubuki Plaxedes.., a final year (MPH- Masters in Public Health) student from .Africa University..... I am carrying out a study on risks associated with contracting diarrhea in children under 5 years in Marondera district..... I am kindly asking you to participate in this study by answering ...../filling in.....

What you should know about the study:

Purpose of the study:

The purpose of the study is to prevent and control diarrhea in children under 5 .years.(state what the study is designed to achieve). You were selected for the study because .you presented with your child at Nyameni / Dombotombo /.Nyembanzvere or Marondera Provincial Hospital .with diarrhea or for other treatments between 1/1/2021 to 28/2/2021.and 69 other participants are involved too.....(state why the participant was chosen and how many other participants are involved).

Procedures and duration

If you decide to participate you will. .sign .this consent form if you are able to read and write..... It is expected that this will take about ..20 minutes.....(give expected duration of the interview/discussion/activity/etc.

Risks and discomforts

There are no risks and discomforts that will be experienced, save for your time taken only .

Describe any reasonable foreseeable risks, discomforts or inconveniences to the subject/participant (including legal, health, economic or psychological and outline how these will be addressed.)

Benefits and/or compensation

You will gain knowledge on diarrhea , its presentation, management, prevention and control, this will help educate other mothers, because educating one mother you have educated the nation, and benefiting the general public as well as the community at large.

Describe any benefits to the subject or to others which may reasonably be expected from the research. If there are no benefits/compensation please state this clearly. If benefits are to the general population, state this...but don’t make unsustainable promises.

Confidentiality

Should include that any information that is obtained in the study that can be identified with the participant will not be disclosed without their permission. Names and any other identification will not be asked for in the questionnaires.

Voluntary participation

Participation in this study is voluntary. If participant decides not to participate in this study, their decision will not affect their future relationship with .the clinic or hospital staff.....(participant's organisation or other authority) If they chose to participate, they are free to withdraw their consent and to discontinue participation without penalty.

Offer to answer questions

Before you sign this form, please ask any questions on any aspect of this study that is unclear to you. You may take as much time as necessary to think it over.

Authorisation

If you have decided to participate in this study please sign this form in the space provide below as an indication that you have read and understood the information provided above and have agreed to participate.

---------- ----------

Name of Research Participant (please print) Date

Signature of Research Participant or legally authorised representative

If you have any questions concerning this study or consent form beyond those answered by the researcher including questions about the research, your rights as a research participant, or if you feel that you have been treated unfairly and would like to talk to someone other than the researcher, please feel free to contact the Africa University Research Ethics Committee on telephone (020) 60075 or 60026 extension 1156 email aurec@africau.edu

Name of Researcher -----Plaxedes Mutubuki----------signature-  ----------

Appendix D: AUREC Approval Letter

Investing in Africa's future

AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE (AUREC)

P.O. Box 1320 Mutare, Zimbabwe, Off Nyanga Road, Old Mutare-Tel (+263-20) 60075/60026/61611 Fax: (+263 20) 61785 website: www.africau.edu

Ref: AU2123/21 24 June, 2021

Plaxedes Mutubuki

C/O CHANS

Africa University

Box 1320

Mutare

RE: DIARRHEA IN CHILDREN UNDER 5 YEARS IN MARONDERA DISTRICT, MASHONALAND EAST ZIMBABWE

Thank you for the above titled proposal that you submitted to the Africa University Research Ethics Committee for review. Please be advised that AUREC has reviewed and approved your application to conduct the above research.

The approval is based on the following.

a) Research proposal
b) Data collection instruments
c) Informed consent guide

APPROVAL NUMBER AUREC 2123/21

This number should be used on all correspondences, consent forms, and appropriate documents.

· **AUREC MEETING DATE NA**

· **APPROVAL DATE** June 24, 2021

· **EXPIRATION DATE** June 24, 2022

· **TYPE OF MEETING** Expedited

After the expiration date this research may only continue upon renewal. For purposes of renewal, a progress report on a standard AUREC form should be submitted a month before expiration date.

SERIOUS ADVERSE EVENTS All serious problems having to do with subject safety must be reported to AUREC within 3 working days on standard AUREC form.

MODIFICATIONS Prior AUREC approval is required before implementing any changes in the proposal (including changes in the consent documents)

TERMINATION OF STUDY Upon termination of the study a report has to be submitted to **AUREC. Yours Faithfully**

MARY CHINZOU – A/AUREC ADMINISTRATORFOR CHAIRPERSON,
AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE

Appendix E: APPROVAL LETTER FROM DMO MASHONALAND EAST

ALL OFFICIAL COMMUNICATIONS SHOULD NOT BE ADDRESSED TO INDIVIDUALS
Email mahusekwahospital@gmail.com
TELEPHONE +263737600940, +263782491879

Reference:

MINISTRY OF HEALTH & CHILD CARE
MAHUSEKWA DISTRICT HOSPITAL
P.O. BOX 290
MARONDERA

DATE: 23 FEBRUARY 2021

RE: APPROVAL TO CARRY OUT RESEARCH ON DIARRHOEA IN MARONDERA DISTRICT: MUTUBUKI PLAXEDES MPH STUDENT WITH AFRICA UNVERSITY IN MUTARE:

I have authorized the above named MPH student to carry out her research project in my district.

Wish all the best in your studies.

Yours sincerely

DR D. MADORO