

SAINT PAUL HOSPITAL MILLENNIUM MEDICAL COLLEGE

DEPARTMENT OF PUBLIC HEALTH

Ethiopian Field Epidemiology Training Program (EFETP)



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St. Paul's Hospital Millennium Medical College

**Prevalence of cutaneous anthrax and associated factors among out patients
who visited selected public health facilities in Waghimra Zone- facility based
record review, 2014-2018**

By

Fentaw Yimam (MD)

**Thesis Submitted to St. Paul's Hospital Millennium Medical College
(SPHMMC), Department of Public Health for Partial Fulfillment of the
Degree of Masters of Public Health in Field Epidemiology**

September, 2019

Addis Ababa, Ethiopia

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Advisors,

Samrawit Solomon (MD, MPH)

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Contents

Acknowledgements.....	i
List of tables	iv
List of figures.....	v
Acronyms	vi
Abstract.....	vii
1 Introduction	1
1.1 Background	1
1.2 Statement of the problem	2
1.3 Significance of the study	3
1.4 Literature review.....	4
2 Objectives.....	6
2.1 General objectives	6
2.2 Specific objectives.....	6
3 Methods.....	7
3.1 Study area and period.....	7
3.2 Study design.....	8
3.3 Source & Study population	8
3.4 Sample size determination and sampling procedure	8
3.5 Variables.....	8
3.5.1 Dependent/ Outcome variable	8
3.5.2 Independent variable/s.....	9
3.6 Data collection	9
3.7 Data quality control	9
3.8 Data processing and analysis	9
3.9 Ethical consideration & dissemination of results	10
3.10 Operational definition.....	10
4 Results.....	11
4.1 Binary logistic regression	13
4.2 Multivariable logistic regression	14
5 Discussion.....	15
6 Limitations.....	17

7	Conclusions	18
8	Recommendations	19
9	References	20
10	Annexes.....	22
10.1	Facility based record review check list/ questionnaire.....	22

List of tables

Table 1 table showing different categories by the status of cutaneous anthrax Waghimra zone 2014-2018 (N=422)	12
Table 2 Bi-variate logistic regression to show association of some factors with outcome variable	13
Table 3 Multivariable logistic regression showing association of factors with cutaneous anthrax	14

List of figures

Figure 1 Map of ethiopia showing Amhara region and Wag himra zone	7
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Acronyms

AOR	Adjusted Odds Ratio
CDC	Center for Disease prevention and Control
CI	Confidence Interval
GI	Gastro Intestinal
HCA	Human Cutaneous Anthrax
HC	Health Center
NGO	Non Governmental Organization
OPD	Out Patient Department
OR	Odds Ratio
PHEM	Public Health Emergency Management
PI	Principal Investigation
QGIS	Quantum Geographic Information System
RHB	Regional Health Bureau
RR	Relative Risk
SPHMMC	St. Paul's Hospital Millennium Medical College
SPSS	Statistical Package for Social Sciences
WHO	World Health Organization
ZHD	Zonal Health Department

Abstract

Background: anthrax is primarily a disease of animals caused by bacteria called *Bacillus anthracis*, humans contracted from the disease when they have contact with animal or animal products. Human Cutaneous Anthrax (HCA) or cutaneous anthrax is the most abundant form of anthrax worldwide.

Method: We selected two public Hospitals in the Zone to determine the prevalence as well as the possible risk factors of cutaneous anthrax in the area. We conducted a facility based cross sectional study design. Patient records were reviewed from these selected Hospitals.

Results: A total of 422 patient cards were reviewed of which 229(54.3%) belongs to male patient records and 193 (45.7%) for females. Based on the records reviewed the overall prevalence of cutaneous anthrax was 12%. Slaughtering/skinning of sick/dead animal (AOR=3.04; 95%CI=1.37-6.76), presence of skin breach or cut (AOR= 10.41; 95% CI=4.77-22.69) and eating raw/ undercooked belonging to sick/ dead animal meat (AOR=6.78; 95% CI=2.94-15.63) were among the risk factors to develop cutaneous anthrax.

Conclusions:

The prevalence of human cutaneous anthrax in Waghimra zone was very high. We recommend healthcare providers to document patient information on the patient record whoever comes to their facility for medical care

1 Introduction

1.1 Background

Human cutaneous anthrax (HCA)/Cutaneous anthrax is one of the three forms of anthrax (cutaneous anthrax, inhalational anthrax and gastrointestinal anthrax) in humans caused by a gram positive, spore forming rod, non motile bacteria called *Bacillus anthracis* (1). The most abundant form of anthrax is cutaneous anthrax which accounts more than 95% of the other forms (2). Anthrax is predominantly a disease of animals; especially herbivores, humans almost invariably contract disease directly or indirectly from animals or animal products although there are several cutaneous anthrax cases reported from *B.anthraxis* spores from soil as it contaminate soil and survive for several decades in it. There are reports of cutaneous anthrax contracted from laboratory. It is generally accepted that *B. anthracis* is non-invasive and that the spores must gain access to sub epidermal tissue through a cut, breach, abrasion or insect bite before infection can occur. No evidence of person-to-person transmission of *B. anthracis* (1,2). The incubation period for cutaneous anthrax was 1-7 days but it can reach up to 60days and clinical features usually begins as a small, painless, pruritic papule on an exposed surface, which progresses through a vesicular stage into a depressed black eschar; the eschar is often surrounded by edema or erythema and may be accompanied by lymphadenopathy (3). Anthrax cases including the cutaneous forms are an immediately reportable disease to the national PHEM from all parts of the country starting from the lowest health office to the national level i.e. upon encountering anthrax in community, health facilities information to the Woreda PHEM focal person in 30 minutes. The Woreda health office has to notify to the Zonal Health Department (ZHD) within 30 minutes, when the ZHD intern report to the Regional Health Bureau (RHB) within 30 minutes. Finally the RHB has to report to the national PHEM in 30 minutes. The overall time that should take to reach to the national PHEM not more than 2 hours totally(4).

1.2 Statement of the problem

Despite the incidence of anthrax has diminished in recent year in developed countries, it still remains of important public health concern in underdeveloped nations where animal husbandry remains a mainstay and veterinary vaccinations have limited penetration (5).

There is very limited data available worldwide regarding the prevalence of cutaneous anthrax cases but the burden of the problem mentioned in several countries in terms of crude numbers, number of outbreaks etc. It is said that cutaneous anthrax is the most common naturally occurring form of anthrax worldwide with an estimated 20,000 cases reported annually from all over the world and the number of cases varied with 10,000-100,000 (6).

The distribution or numbers of cases as well as the factors affecting cutaneous anthrax vary from country to country. Significant number of cases documented in Chad, Ethiopia, Zambia, Zimbabwe, India, Bangladesh etc (7). For example, in one study conducted in Zimbabwe between the years 1979-1985 there were more than 10,000 human cutaneous anthrax cases reported the risk of which was unprecedented outbreak in cattle and hence transmitted to humans (8).

In one study (a facility based retrospective survey) conducted in Tanqua-Abergelle District, Northern Ethiopia, between 2008-2012 from different health facilities in the district, there were a total of 2,680 human anthrax cases almost all of them cutaneous and majority of them 1,748(65.2%) from the low land area (9). This study tried to explain seasonality, being in low land area and being poor economic back ground which forced them to eat meat from dead animals as a risk factor for problem. They recommend vaccine for livestock and early treatment of the human cutaneous anthrax cases.

Ethiopia is one of African countries with high number of cutaneous anthrax cases, the distribution, burden of disease vary from place to place. In a surveillance data analysis conducted from Amhara PHEM database in 2012/2013, human anthrax reported to Amhara regional health bureau showed, more than 70% of anthrax cases were from Waghimra zone, one of the known anthrax endemic area in Ethiopia (10). But this data didn't show the prevalence of the epidemic nor did the risks associate factors.

1.3 Significance of the study

Anthrax, including the cutaneous form is important globally as it is one of the diseases used as bioweapon though very rare in its cutaneous form. Bio-terrorism has become a major concern in the post-9/11 era.

Because of the above reason and its high epidemic potential (though not common in the cutaneous form) anthrax is one of the immediately reportable diseases to the national PHEM in Ethiopia (4).

The disease is found globally especially in developing countries like Ethiopia, where about 80% of the population depend on agriculture and have direct contact with livestock or other domestic animals, making the countries vulnerable to the spread of zoonotic diseases including anthrax.

Anthrax especially the cutaneous form is endemic in Ethiopia and Waghimra zone is one of the highest numbers of cutaneous anthrax cases reported from. Although few studies reported from different parts of the country, there is no adequate information especially in terms of prevalence/magnitude, distribution, risk factors (11). So this study may help to gather the information especially with respect to the prevalence of cutaneous anthrax and possible risk factors for the epidemic in the Zone. This information in turn will help in developing controlling and prevention strategies not only for the study but also for the country as a whole.

1.4 Literature review

Worldwide, anthrax occurs at a low incidence in developed countries but remains endemic in African and Asian regions. There are approximately 10-100 thousand human incidences of anthrax annually throughout the world with significant numbers of cases in Chad, Ethiopia, Zambia, Zimbabwe and India (8). This study doesn't show specific numbers or prevalence of cutaneous anthrax in these countries.

It is known that anthrax still has a nearly worldwide distribution though it varies from country to country and it is estimated that about 20,000–100,000 cases reported annually. It poses a major public health threat in regions of the Middle East, Africa, central Asia, South America, and Haiti etc.(12).

Although it is less common in cases of the cutaneous forms of anthrax, *B. anthracis* is always placed high on the list of potential agents with respect to biologic warfare and bioterrorism because of its robust nature and persistence of spores, the ability of aerosolized spores to readily infect by inhalation, and the high mortality rate for resultant anthrax cases (13).

Cutaneous anthrax is the most abundant form of anthrax worldwide (about 95% of the other forms) but carries the lowest mortality rate when compared from the other two forms of anthrax (gastrointestinal, and inhalational anthrax) especially when timely diagnosed and treated (14). But as discussed earlier untreated cases of cutaneous anthrax had a mortality rate of 5- 20%.

In one study (a surveillance data analysis) conducted in Georgia from 2008-2015, a total of 911 HCA cases were documented of which 76.3% were males. Living near pastoralist route, aOR, 2.74 (95% CI =1.57-4.76) and handling animal products 4.36 (2.61-7.26), were the identified risk factors (15). In the same country on another study conducted from 2010–2012, a total of 251 HCA (Human Cutaneous Anthrax) cases have been reported. With 84% of the cases were males involved in butchering/slaughtering cattle as risk factors (14,15).

Several outbreaks have been documented from different parts of India, of which the one reported in Orissa in 2013 was the most devastating one when several people were affected from the epidemic, mostly cutaneous form of anthrax and other forms. Even deaths were also reported especially from other forms of anthrax and the epidemic was due to consumption of infected goat meat(16).

Bangladesh also has experienced a number of outbreaks of cutaneous anthrax in recent years. In 2010 the epidemic affects 12 districts with a total of 607 HCA cases. The outbreak investigation showed slaughtering of infected cattle and selling or eating contaminated meat had association with the disease. Another outbreak of cutaneous anthrax from April to September 2011 affected two north-western district of Bangladesh reported 107 cases (17).

A health facility based record review conducted in Tanzania from 2006-2016, identified 330 HCA cases and presence of sick livestock as risk for human cases. Although the prevalence in the study was not mentioned, there were increased incidences of anthrax cases (18).

In another study conducted in Zimbabwe the risk factors associated with cutaneous anthrax include Having cattle dying in one's household (AOR= 8.8(95% CI 2.3-33.7), having cuts (AOR= 23 (95% CI 2.5-212), and assisting with cutting and cooking infected meat AOR= 3.7 (95% CI 1.03-13.2), were risk factors for contracting anthrax in Kuwirirana ward.

In another study conducted from surveillance data analysis in Amhara region between 2010-2014, from the total cases reported to Amhara regional health bureau more than 50% reported cases were from Waghimra Zone (19).

Although the prevalence of the epidemic is reported from different part of the country in varying degree, most of the reports didn't address what risks will be associated with the disease clearly and what to do in the future. This study might explain about risks associated with the cutaneous form of anthrax as well as its prevalence/ magnitude in in one of the most cutaneous anthrax prevalent area(20).

2 Objectives

2.1 General objectives

- To determine the prevalence and associated risk factors of cutaneous anthrax among the patients who visited selected health facilities in Waghimra Zone, 2014-2018.

2.2 Specific objectives

- To determine the prevalence of cutaneous anthrax at health facilities in Waghimra Zone, 2014-2018.
- To determine the factors associated with cutaneous anthrax in facilities visited in Waghimra Zone, 2014-2018.

3 Methods

3.1 Study area and period

The study was conducted in Waghimra Zone, which is located at a distance of 720 Km North West from Addis Ababa and 520 Km from the regional capital city, Bahir-Dar. The Zone has a total population of 456,585 with sex composition of 228,966 male and 227,620 female. The zone shares Geographical borders to the East and North with Tigray regional state, South with North Wollo and West with South and North Gondar. The zone is administratively sub divided into 7 Districts. The study was conducted from July –August, 2019

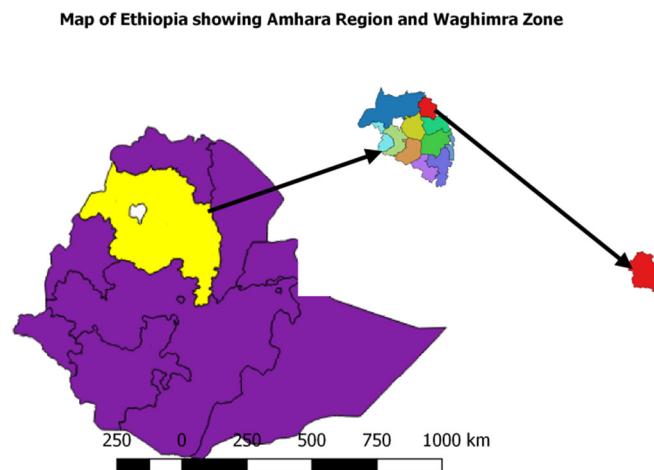


Figure 1 Map of ethiopia showing Amhara region and Wag himra zone

3.2 Study design

Facility based record review-A cross sectional study design was conducted

3.3 Source & Study population

The source populations were all people who visited the outpatient department in the selected health facilities during the study period and who were residents of Waghimra zone. The study populations were those patients who visited the outpatient department (OPD) in these selected public health facilities in the study period and.

3.4 Sample size determination and sampling procedure

Using single population sample size estimation formula, $n = (Z\alpha/2)^2 X p (1-p)/d^2$. Where n is sample size, p is assumptive proportion (50% since there were no credible evidence about the prevalence of cutaneous anthrax previously), $(Z\alpha/2 = 1.96)$ 95% confidence level and d is the margin of error or absolute precision which is 0.05.

$$n = (1.96)^2 \times 0.5(1-0.5) / (0.05)^2 = 384 \text{ with } 10\% \text{ for possible incomplete data,}$$

$$n = 384 + 38 = 422.$$

Before starting the data collection, we visited health facilities i.e. health centers (HCs) such as tsetseka HC, Sekota HC, missiora HC and Hospitals to roughly assess the patient record documentation. From these we managed to found in most of the patients records from HCs there were no documentation of patient information but in hospitals there were a relatively better documentation of information in the records and hence we selected the two hospitals (Tefera Hailu memorial hospital in Sekota and Ziquala primary hospital in Ziquala) purposively. We also visited the Zonal health office especially the PHEM department to assess the number of cutaneous anthrax cases from different woredas in the Zone during the study period. Based on these assessment more number of cutaneous anthrax were reported from Ziquala Woreda and hence majority of the sample size assigned from Ziquala hospital.

3.5 Variables

3.5.1 Dependent/ Outcome variable

Cutaneous anthrax

3.5.2 Independent variable/s

Socio demographic characteristics: age, sex, marital status, occupation, educational status, address.

Other variables: history of contact with animal skin or fur, involved in slaughtering/ skinning sick or dead animal, eating/ handling (raw/ undercooked) meat belonging to dead/ sick animal, presence of abrasion/ breach/ cut on the skin, presence of sick person in a family.

3.6 Data collection

From the zonal PHEM data we observed in the study period, most of the cutaneous anthrax cases were from Ziquala Woreda hence we assigned most of the samples from Ziquala hospital purposively. We collected OPD registers of all patients who visited these facilities in the study period. We set a sampling interval from the total number of patients visiting these hospitals and sample size calculated, and used systematic random sampling when collecting the desired sample size.

3.7 Data quality control

Before the main data was collected pre-testing was conducted in few numbers of samples. Three experienced nurses and a supervisor who was a senior nurse in each Hospital were trained on how to collect the patients of interest from the register. Data collectors listed the patient record numbers of the patients of interest and gave to the persons who collected the patient record from record room. The data collectors fill important variables from the record in to the check list on daily basis. A supervisor and principal investigator PI used to check about the completeness, duplication, any missing data, and relevance of the data on daily basis.

3.8 Data processing and analysis

After the data entered to the Epi-info version7 data edited (checked for completeness, accuracy, consistency, data summarization...). Data exported to SPSS version 23, analyzed and different frequency tables, graphs and descriptive summaries used to describe the study variables.

Bivariable analyses were done to check association between two variables. From these results variables having significant association with the outcome (dependent) variables i.e. p-value with less than 0.2 were involved in multiple logistic regression to see the adjusted association with the outcome variable.

After multiple logistic regression p- value <0.05 with valid 95% CI (CI which didn't include 1) were selected and used for final association with the outcome variable and interpretation.

3.9 Ethical consideration & dissemination of results

Since the information of patients taken from their charts, consent from the patients as well as the parents were not needed. Yet individual confidentiality like name of the patients from the charts not exposed. The study conducted after getting approval from the Ethical Review Board of the Department of Public Health, St. Paul's Hospital Millennium Medical College, and SPHMMC. A letter of support which indicates the objective of the study was written to Amhara Regional health bureau, from SPHMMC. Subsequently permission letter was given from the regional health bureau to the Waghimra Zonal Health Office. The Zonal Health Office in turn gave a letter of permission to the concerned health facilities to conduct the research. Information about the result will be disseminated to the stakeholders concerned.

3.10 Operational definition

Human Cutaneous Anthrax-it is the commonest form of anthrax in humans characterized by skin lesion usually begins as a small, painless, pruritic papule on an exposed surface, which progresses through a vesicular stage into a depressed black eschar; the eschar is often surrounded by edema or erythematic and may be accompanied by lymphadenopathy

Other skin lesions- patients who visited the facilities selected and diagnosed on their records as other forms of skin lesions like- eczema, cellulites, impetigo, scabies etc., other than cutaneous anthrax.

Other- These were patients who didn't have skin lesion and were visiting the health facilities for other conditions such as pneumonia, malaria, diarrheal diseases, typhoid fever etc.

4 Results

Almost all of the patient records reviewed from the two public Hospitals were having complete data with few irregularities hence we include all the samples collected in this study. So the response rate was 100%. From the selected public health facilities in the Waghimra Zone i.e., Tefera Hailu Primary Hospital in Sekota city and Ziquala Primary Hospital in Ziquala city, a total of 422 patient records were reviewed. Among which 229(54.3%) were males and 193 (43.7%) females. The median age of the patients was 33 years. The mean age of the patients were 32 ± 1 year and majority of the patients were from Ziquala Hospital 264 (62.6%) and the remaining 158 (37.4%) were from Tefera Hailu Primary Hospital.

Among the human cutaneous anthrax cases, 34(66.7%) were from Ziquala hospital and 33.3% from Tefera Hailu memorial hospital among these cases 29 (56.9%) were males and 43.1% were females. The mean age of human cutaneous anthrax patients were 35.7 years and the median age was 36 years. Among the non- cutaneous anthrax cases 84(22.6) patients were a case of other skin lesion and 287(87.4%) cases were having other diseases such as pneumonia and other respiratory diseases, diarrheal diseases, typhoid cases, malaria, other febrile illnesses etc.

The overall prevalence of human cutaneous anthrax (HCA) based on the information from the two facilities during the study period were $51/422 \times 100$ (12%) of which 12.88% were from Ziquala Hospital and the 10.8% were from Tefera Hailu Primary Hospital.

The most frequent features seen among human cutaneous anthrax patients were black eschar 41(80.4%) followed by itching and swelling/edema with 49(96%) and 41(80.4 %) respectively.

Table 1 table showing different categories by the status of cutaneous anthrax Waghimra zone 2014-2018 (N=422)

Characteristics		HCA		Total (N=422)
		Yes	No	
Age	=<5	1 (2%)	28 (7.5%)	29
	6-15	3 (5.9%)	60 (16.2%)	63
	16-30	8 (15.7%)	99 (26.7%)	107
	31-45	32 (62.7%)	88 (23.7%)	120
	46-60	5(9.8%)	73(19.7%)	78
	Above 60	2 (3.9%)	23(6.2%)	25
Sex	Male	29 (56.8%)	200 (53.9%)	229
	Female	22 (43.2%)	171(46.1%)	193
Occupation	Farmer	34(66.7%)	176(47.4%)	210
	Housewife	11(21.6%)	82 (22.1%)	93
	Student	5(9.8%)	77 (20.6%)	82
	NA	1 (1.9%)	36 (9.9%)	36
Educational status	Uneducated	3 (5.9%)	11 (2.9%)	14
	Secondary	7(13.7%)	70(18.9%)	77
	Write and Read	17 (33.3%)	96(25.9%)	113
	Above secondary	2 (3.9%)	11(2.9%)	13
	Primary	21 (41.2%)	145 (39%)	166
	NA	1 (2%)	38 (10.4%)	39
Address	Sekota	17 (33.3%)	141 (38%)	158
	Ziquala	31 (60.7%)	202 (54.4%)	233
	Dahana	3 (6%)	28 (7.6%)	31
Site of body involved	Arm	11 (21.5%)	21 (5.7%)	32
	Hand	32(62.7%)	37(10%)	69
	Finger	0	11 (2.9%)	11
	Face	4 (7.9%)	27(7.3%)	31
	Neck	4 (7.9%)	14 (3.8%)	18
	Other	0	261(70.3%)	261
Sick person in a family	Yes	44(86.3%)	123(33.2%)	167
	No	7(3.7%)	248(76.8%)	255
Swelling/edema	Yes	41(80.4%)	54(14.6%)	95
	No	10(19.6%)	317(85.4%)	327
Black Eschar	Yes	41(80.4%)	3(0.8%)	44
	No	10(19.6%)	368(99.2%)	378
Feeling pain	Yes	22(43.1%)	95(25.6%)	117
	No	29(56.9%)	276(74.4%)	305
Itching	Yes	49(96%)	28(7.5%)	77
	No	2(4%)	343(92.5%)	345
Other skin lesions	Yes	0	84(22.6%)	84
	No	51(100%)	287(87.4%)	338

4.1 Binary logistic regression

All the independent variables were tested by binary logistic regression to see if they have any association with the outcome variable. So the independent variables having association with the outcome variable were identified.

Table 2 Bi-variate logistic regression to show association of some factors with outcome variable

Factors		HCA		P- value	COR	95% CI
		Yes	No			
Age category	Under 5	1	28	1		
	6-15	3	60	0.77	1.40	0.14-14.07
	16-30	8	99	0.44	2.26	0.27-18.87
	31-45	32	88	0.007*	10.18	1.33-77.94
	46-60	5	73	0.55	1.92	0.21-17.15
	above 60	2	23	0.47	2.43	0.21-28.59
Educational status	Uneducated	3	11	1		
	Secondary	7	70	0.17	0.37	0.08-1.63
	Write and read	17	96	0.54	0.65	0.16-2.57
	Above secondary	2	11	0.69	0.67	0.09-4.80
	Primary	21	145	0.35	0.53	0.14-2.06
	NA	1	38	0.08	0.10	0.01-1.02
Sex	Male	29	200	0.60	1.17	0.65-2.11
	Female	22	171	1		
Occupation	Farmer	34	176	0.025*	10.06	1.34-75.45
	Housewife	11	82	0.053	7.7	0.98-60
	Student	5	77	0.17	4.4	0.53-35.91
	NA	1	36	1		
Slaughtering/ skinning sick, dead animal	Yes	26	29	0.0001*	11.76	6.06-22.81
	No	25	342	1		
Contact with animal skin, fur	Yes	43	117	0.0001*	10.33	4.87-21.89
	No	8	254	1		
Presence of skin cut/breach	Yes	38	44	0.001*	20.11	10.09-40.05
	No	13	327	1		
Eat(raw/undercooked) sick /dead animal meat	Yes	41	80	0.0001*	13.51	6.64-27.48
	No	10	291	1		

4.2 Multivariable logistic regression

Independent variables having significant association with the outcome variable in the bivariate logistic regression analysis i.e. p-value less than 0.2 were included in the multivariable logistic regression analysis to control confounding and to find the adjusted association with the outcome variable.

Table 3 Multivariable logistic regression showing association of factors with cutaneous anthrax

Factors	HCA		P-value	AOR	95%CI
	Yes	No			
Slaughtering, skinning dead/sick animal	26	29	0.006	3.04	1.37-6.76
	25	342	constant		
Any cut/breach on skin	38	44	0.0001	10.41	4.77-22.69
	13	327	constant		
Eat raw, undercooked (dead/sick) animal meat	41	80	0.0001	6.78	2.94-15.63
	10	291	constant		

This result shows that individuals involved in slaughtering, skinning dead or sick animal had increased risk of contracting cutaneous anthrax by 3 times (AOR=3.04; 95%CI=1.37-6.76) when compared to those who didn't involve in these activities. This result also shows that individuals having skin breach/ cut increased risk of contracting cutaneous anthrax by 10 times (AOR=10.41; 95% CI=4.77-22.69) when compared to those who had intact skin. In the same way people eating raw or undercooked meat of a sick/dead animal had increased risk of contracting cutaneous anthrax by 6.8 times (AOR=6.78 ; 95%CI= 2.94-15.63) when compared to the people who didn't expose themselves to the conditions mentioned.

5 Discussion

Cutaneous anthrax is by far the most abundant forms of anthrax worldwide. It is more common in some parts of the world such as Southeast Asian countries and sub Saharan African countries including Ethiopia.

In Ethiopia, Waghimra zone is one of the areas where large number of cutaneous anthrax cases to the regional as well as national PHEM data every year. So it is important to know the prevalence and associated factors of cutaneous anthrax for planning health care service, proper management and prevention strategies.

In this study the prevalence of cutaneous anthrax in the Zone based on cases from the selected facilities were very high, especially in the Ziquala hospital. There were no much credible information regarding the prevalence of anthrax in general and the cutaneous form of anthrax in particular documented previously both at the national and regional levels to compare with this finding. Even little is known about the prevalence of cutaneous anthrax worldwide based on the articles searched from known journals rather the burden of the epidemic were frequently in terms of crude numbers incidences etc.

Farmers and the age groups between 31 and 45 were most affected in the findings seen in the findings this might be because the farmers were mostly involved with animals in day today activities. The most frequently affected body in this study was 'hands', and this might be due to the fact that most of the activities performed in every day today activity is by our hands and hence there will be a chance for the bacteria to enter to the body should there be a skin breach or cut.

Our finding shows slaughtering & skinning of dead or sick animal increased the risk of being infected by cutaneous anthrax. Several studies showed that contact with sick or dead animal such as during slaughtering, skinning, handling meat of such animal will lead to get the bacterial spore access to humans if the animal already infected from anthrax. This finding has similarities with a study done in Tanzania in 2007. In this outbreak a case-control study was conducted with cases that have classical features of cutaneous anthrax and controls who didn't have the symptom but were residents of the cases. From multivariate analysis, assisting with cutting or cooking infected meat (AOR= 3.7 (95% CI 1.03-13.2)) was a risk factor to develop cutaneous anthrax in

Kuwirirana ward, Tanzania (18). Another study (a surveillance data analysis) conducted in Georgia 2008-2015 supported our finding. In that study handling animal products (AOR=4.36(95% CI 2.61-7.26)) was a risk factor to contract cutaneous anthrax (15).

This study also showed presence of any cut/breach on skin had an increased risk of developing cutaneous anthrax. As discussed in different sections previously, in order for the *B. anthracis* spore to cause the cutaneous form of anthrax from whatever source (sick animal products like animal skin, fur, meat, from soil, from lab sources etc.), there should be a skin breach, cut or damage as intact skin didn't allow the bacteria to reach epidermal area. Studies which support this finding include the study conducted in Tanzania in 2007 that shows having cuts (AOR= 23 (95% CI 2.5-21.2)) was a risk factor for the development of cutaneous anthrax (17). Another study conducted in 2012 in Jiangsu, Eastern china about cutaneous anthrax outbreak on patients who visited a facility. In that study, investigators found that presence of a skin damage before exposure (slaughtering& skinning) an infected cow RR= 2.8(95% CI 1.4–5.7) was the risk factor to develop the cutaneous anthrax, even the index case in that outbreak had skin damage (20).

The other important result we found from the multivariate analysis of this study is that eating raw/undercooked (dead/sick) animal meat increased the risk of getting cutaneous anthrax.

When a person eats raw or undercooked meat from an animal infected with anthrax, they can develop gastrointestinal anthrax. Once ingested, anthrax spores can affect the upper gastrointestinal tract (throat and esophagus), stomach, and intestines (21).

Unlike our finding above, eating raw or undercooked meat as risk factor to develop cutaneous anthrax, several studies showed that eating raw or undercooked meat from sick or dead animal because of anthrax, will lead to the gastro intestinal form of anthrax. These people might contract from the cutaneous anthrax during handling the meat, preparing, cutting etc. of the meat.

6 Limitations

- One of the most important limitations seen during the data collection was incomplete documentation of necessary information on patient records especially in the visited health centers
- The other limitation was misplacing/difficulty in finding of patients records especially those of previous year patient records.
- Purposive selection of the two hospitals were also one of the limitations these might not been the representatives to generalize the zonal prevalence.

7 Conclusions

- This study showed a higher prevalence of cutaneous anthrax in the zone based on the data from these facilities.
- Males, farmers and age groups between 31 and 45 years were mostly affected.
- The commonest site of the body involved were hands followed by arms
- The most frequent features were black eschar, itching and swelling
- Slaughtering, skinning or handling of meat that belongs to the dead or sick animal from anthrax, presence of skin breach or cut, eating raw or undercooked meat of sick or dead animal from anthrax were the major risk factors observed.

8 Recommendations

- The health care providers have to document all the necessary information about the patient in patient's records whenever they visited their health facility. This should be a tradition/habit for healthcare providers to document not only at hospital level but also at clinics, health centers etc. so that there will not be problem in finding the necessary variables from records for researches regarding anthrax in particular and other record based researches in general.
- Health care providers has to be familiarize about cutaneous anthrax not to over diagnose the other skin infections
- Anthrax including the cutaneous form has to be reported immediately to the national PHEM but in all the visited Woreda health offices, anthrax was reported weekly even to the zonal health department and regional PHEM. So the health offices at each level should urge the surveillance report to reach on time at respective health offices as per the time to do so.
- The community education and mobilization regarding on the way how cutaneous anthrax is transmitted, early treatment and means of prevention has to be conducted or strengthened further.
- Surveillance system should be strengthened further not to miss the anthrax cases in general and the cutaneous form in particular. At the same time the surveillance system evaluation has to be conducted side by side to be sure that the system is functioning well.

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10 Annexes

10.1 Facility based record review check list/ questionnaire

Patient card number_____Date of data collection_____

Date _____ seen _____ at _____ health
facility _____ Region _____ Zon
e _____ District _____ kebele _____ Facility
name _____

Demographic characteristics

1. Sex Male ☐ Female ☐

2. Age _____

3. Occupation:

a. Farmer b. House wife c. Student d. Merchant f. Employees (Government/NGO)

7. Unemployed 8. Other _____

4. Educational status:

1. Illiterate 2. Write and read 3. Primary 4. Secondary 5. Above secondary

Clinical history of the disease

1. Date of onset of symptom _____

2. Sick person in the family _____ how many....

3. Features seen: 1. itching 2. Edema (swelling) 3. Skin lesion: black, papules,
vesicular

4. Site of body involved: 1. Hand 2. Finger 3. Face 4. Neck 5. Arm, 6. Forearm, 7. Other

Exposure status/ risk factors

1. Own animal (cattle) sick/ dead? Yes/No

2. Involved in:

a. Skinning/butchering, cutting/cooking meat? Yes/ No

b. Eating raw/undercooked meat? Yes/ No

c. any cut/breach on skin? Yes/ No

Laboratory

Specimen taken? Yes/No

If yes, which specimen taken_____

Treatment

Took treatment? Yes/ No

Which treatment _____

Outcome _____