

**Original Article****Open Access****Clinical characteristics and outcomes of patients with acute watery diarrhoea admitted to the Cholera Treatment Center of Yekatit-12 Teaching Hospital, Addis Ababa, Ethiopia**^{*1,2}Mengistu, M. D., ¹Challa, G., and ¹Rorisa, M.¹Department of Internal Medicine, Yekatit-12 Hospital Medical College, Addis Ababa, Ethiopia²Department of Medical Physiology, School of Medicine, Addis Ababa University, Addis Ababa, Ethiopia*Correspondence to: mekoyamengistu@gmail.com**Abstract**

Background: Cholera remains a major public health concern in low-income countries where the spread of disease is exacerbated by poor water supply, hygiene, and sanitation. Ethiopia has continued to face recurrent cholera outbreaks despite efforts to prevent and control the disease. The aim of the study was to assess the clinical characteristics, and outcomes among patients with acute watery diarrhea admitted to Cholera Treatment Center (CTC) of Yekatit-12 Teaching Hospital, Addis Ababa, Ethiopia.

Methodology: A hospital-based cross-sectional study was conducted from July 1, 2023 to Feb 30, 2025 on 176 patients with acute watery diarrheal disease admitted to the CTC during two major rainy seasons. Relevant clinical variables including socio-demographic data, co-morbidities, clinical presentations, risk factors, complications, outcomes and laboratory investigation results were obtained. Descriptive statistics were used to summarize the data and associations were tested using logistic regressions with statistical significance set at p value <0.05 .

Results: Of the 176 patients, 52.0% were female and 90.0% were ≥ 15 years old. Vomiting and diarrhea were the predominant presenting symptoms (71.8%); 36.7% and 50.8% of patients had some dehydration and severe dehydration at admission, respectively. Electrolytes disturbance was the leading complication with hypokalemia (45.8%) being the most common, followed by hyponatremia (34.5%), and hypochloremia (23.7%). Acute kidney injury (AKI) occurred in 38.4% of the patients. The risk of AKI among patients >45 years was 5.9 times higher than patients <15 years of age (95% CI: 1.501-23.3, $p=0.01$) and patients with severe dehydration had 3.96 times higher risk of AKI compared with no dehydration (95% CI: 1.205-13.018, $p=0.023$). The case fatality rate was 6.25%. The common exposures to the disease included eating outside of home (54.0%), and unsafe water consumption (85.0%).

Conclusion: The cholera outbreak was characterized by moderate to severe dehydration, high burden of electrolyte imbalance, AKI and case fatality rate. Early case detection and community water, sanitation and hygiene (WaSH) interventions are recommended to reduce the disease burden, morbidity and mortality.

Keywords: Acute watery diarrhoea; Cholera; Acute kidney injury; Outcome; Ethiopia

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Caractéristiques cliniques et évolution des patients atteints de diarrhée aqueuse aiguë admis au Centre de Traitement du Choléra de l'Hôpital Universitaire Yekatit-12, Addis-Abeba, Éthiopie^{*1,2}Mengistu, M. D., ¹Challa, G., et ¹Rorisa, M.¹Département de Médecine Interne, Faculté de Médecine de l'Hôpital Yekatit-12, Addis-Abeba, Éthiopie²Département de Physiologie Médicale, Faculté de Médecine, Université d'Addis-Abeba, Addis-Abeba, Éthiopie*Correspondance à: mekoyamengistu@gmail.com

Résumé:

Contexte: Le choléra demeure un problème majeur de santé publique dans les pays à faible revenu, où la propagation de la maladie est exacerbée par l'insuffisance de l'approvisionnement en eau, de l'hygiène et de l'assainissement. L'Éthiopie continue de faire face à des épidémies de choléra récurrentes malgré les efforts déployés pour prévenir et contrôler la maladie. L'objectif de cette étude était d'évaluer les caractéristiques cliniques et l'évolution des patients atteints de diarrhée aqueuse aiguë admis au Centre de traitement du choléra (CTC) de l'hôpital universitaire Yekatit-12 d'Addis-Abeba, en Éthiopie.

Méthodologie: Une étude transversale en milieu hospitalier a été menée du 1er juillet 2023 au 30 février 2025 auprès de 176 patients atteints de diarrhée aqueuse aiguë admis au CTC au cours de deux saisons des pluies majeures. Les variables cliniques pertinentes, notamment les données sociodémographiques, les comorbidités, les manifestations cliniques, les facteurs de risque, les complications, l'évolution et les résultats des analyses de laboratoire, ont été recueillies. Des statistiques descriptives ont été utilisées pour résumer les données et les associations ont été testées par régression logistique, le seuil de signification statistique étant fixé à $p < 0,05$.

Résultats: Parmi les 176 patients, 52,0% étaient des femmes et 90,0% étaient âgés de 15 ans ou plus. Les vomissements et la diarrhée étaient les symptômes les plus fréquents (71,8%). À l'admission, 36,7% des patients présentaient une déshydratation légère et 50,8% une déshydratation sévère. Les troubles électrolytiques constituaient la principale complication, l'hypokaliémie (45,8%) étant la plus fréquente, suivie de l'hyponatémie (34,5%) et de l'hypochlorémie (23,7%). Une insuffisance rénale aiguë (IRA) est survenue chez 38,4% des patients. Le risque d'IRA était 5,9 fois plus élevé chez les patients de plus de 45 ans que chez ceux de moins de 15 ans (IC à 95 %: 1,501-23,3; $p=0,01$), et ce risque était 3,96 fois plus élevé chez les patients présentant une déshydratation sévère que chez ceux ne présentant pas de déshydratation (IC à 95%: 1,205-13,018; $p=0,023$). Le taux de mortalité était de 6,25%. Les principaux facteurs de risque étaient les repas pris à l'extérieur (54,0%) et la consommation d'eau non potable (85,0%).

Conclusion: L'épidémie de choléra a été caractérisée par une déshydratation modérée à sévère, une forte prévalence de déséquilibres électrolytiques, une insuffisance rénale aiguë et un taux de létalité élevé. Le dépistage précoce des cas et des interventions communautaires en matière d'eau, d'assainissement et d'hygiène (EAH) sont recommandés pour réduire la morbidité et la mortalité liées à la maladie.

Mots-clés: Diarrhée aqueuse aiguë; Choléra; Insuffisance rénale aiguë; Évolution; Éthiopie

Introduction:

Cholera has been a global threat to health security, particularly in sub-Saharan Africa where outbreaks have become frequent, with increased magnitude and fatalities (1,2). It is one of the key indicators of poor socio-economic development and remains a challenge to countries where access to safe drinking water and adequate sanitation cannot be guaranteed (3). The outbreak requires an immediate response including rapid mobilization of resources including Water and Sanitation, and Hygiene (WaSH) to control the spread and prevent fatalities (3, 4).

Cholera is an extremely virulent disease caused by infection of the intestine with Gram-negative bacteria *Vibrio cholerae*. The onset of illness may be sudden, with profuse, painless, watery diarrhea leading to severe and rapidly progressing dehydration, hypovolemic shock and death (5). Without adequate and appropriate rehydration therapy, severe cholera kills more than 50% of affected individuals but <1% if appropriately treated (5,6). Only 20-25% of cholera cases are symptomatic, of which 10-20% can develop severe disease, and the remaining 80% are asymptomatic but still can transmit the infection (7).

The true global burden of cholera is largely unknown as the passively acquired sur-

veillance data under-reports its cases related to poor surveillance systems, poor laboratory diagnostic capacities, and socio-politico-economic disincentives for reporting in many cholera-endemic countries (8,9). Consistent with this finding, the WHO estimated that only 5–10% of the cholera cases occurring annually are officially reported by member countries (10). Studies show that Africa and southern Asia account for about 99% of the cholera burden worldwide, primarily due to poverty, including inadequate sanitation, contaminated drinking water, poor food hygiene, and lack of health care services (11,12).

Ethiopia, in its long history, has endured several outbreaks of acute watery diarrhea (AWD) due to cholera. Over the recent 9 years alone, there has been reported a total of 99,945 cases, with case fatality rate (CFR) reaching up to 3.13% (13,14). Due to extensive magnitude of the problem, the Ethiopian government established multi-sectoral cholera elimination plan (NCP) and updated its cholera surveillance and outbreak response guidelines (16). The guidelines have incorporated a collaborative effort to monitor and manage cholera outbreaks across borders, refined the case definitions of cholera, and also integrated oral cholera vaccine (OCV) as a crucial component of cholera control and prevention strategy (13,16).

Despite the extensive efforts, in the last

one decade alone, multiple cholera outbreaks have been reported in different regions of the country (9,13,17,18,19). The recent outbreak started in August 2022 in Oromia region of Ethiopia and later spread to other areas of the country, including Addis Ababa, and has been a growing concern (15). Since almost all of the outcome data in Ethiopia were based on the retrospective studies or second-hand data which were less likely to capture the real time account regarding clinical presentations, degree of dehydrations, and complications of cholera, including the mortality rate. Therefore, our facility-based study was aimed to generate first-hand account about the clinical characteristics, risk factors, complications, and treatment outcomes among cholera suspected patients with AWD admitted to Cholera Treatment Center (CTC) of Yekatit-12 Hospital Medical College.

Materials and method:

Study setting:

The study was conducted in the medical isolation ward currently dedicated for Cholera Treatment Center (CTC) after the recent outbreaks of acute watery diarrhea (AWD) at the Yekatit-12 Hospital Medical College from July 1, 2023 to February 30, 2025. The outbreaks reported were mainly during the 2023 and 2024 Ethiopian rainy seasons.

Study design:

A hospital-based cross-sectional study was conducted involving all AWD patients admitted to the CTC of Yekatit-12 Hospital Medical

College after fulfilling the case definition of cholera or tested positive for cholera during the outbreak.

Ethical approval and consent for participant:

This study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical clearance was obtained from institutional review board of Yekatit-12 Hospital medical College. Written informed consent was obtained from the study participants before the commencement of data collection.

Operational definition:

The case definition of cholera in a region where cholera outbreak was declared, is any person aged 2 years or more presenting with or dying from acute watery diarrhea (4). Acute kidney injury (AKI) was diagnosed when there is an absolute increase in serum creatinine (sCr) by ≥ 0.3 mg/dL ($26.5 \mu\text{mol/L}$) within 48 hours or by 1.5 times increase in sCr from baseline within 7 days, or a urine volume of < 0.5 ml/kg/h for at least 6 hours (20). Hypokalemia was defined when the serum potassium level < 3.5 meq/L (21). Hypochloremia was defined as serum chloride level < 96 meq/L (21). Hyponatremia was defined when serum sodium is < 135 mEq/L (21).

Severity of dehydration in a patient with AWD was assessed by using key clinical indicators; (i) No Dehydration (DHN) if no characteristic signs, (ii) Some Dehydration if ≥ 2 of any characteristic signs including ≥ 1 major sign of some DHN, and (iii) Severe Dehydration if ≥ 2 of any characteristic signs including ≥ 1 major sign of severe DHN as shown in Table 1 (4).

Table 1: Classification of the severity of dehydration in patient with acute watery diarrhea in Addis Ababa, Ethiopia

Status	No Dehydration	Some Dehydration	Severe Dehydration
Check for pulse	Present, Rapid	Weak, Thready	No pulse
Patient condition	Well, Alert	Restless, Irritable [‡]	Lethargic or unconscious [‡]
Eye sunken	No	Yes (sunken)	Yes (very sunken and dry)
Mouth and tongue	Moist	Dry	Very dry
Thirst*	Drinks normally	Thirsty, drinks eagerly [‡]	Drinks poorly or not able to drink [‡]
Skin pinch	Goes back quickly	Goes back slowly [‡]	Goes back very slowly (> 2 seconds) [‡]
Decide	The patient has no signs of dehydration	If the patient has ≥ 2 signs, including ≥ 1 major sign, there is some dehydration	If the patient has ≥ 2 signs, including ≥ 1 major sign, there is severe dehydration
Treat	Maintain hydration	Oral rehydration solution	IV + ORS + Antibiotic
	PLAN A	PLAN B	PLAN C

Source: FDEMoH Guideline for Cholera Surveillance and Outbreak Response, 2022.

*Patient should be offered fluid to observe for this sign,

**Abdominal skin has to be pinched and released to observe for this sign,

[‡]Major signs

Data collection:

We utilized KoboToolbox for data collection. In order to ensure the accuracy, completeness, and comparability of data, two senior medical residents were trained to complete data collection format. Relevant clinical data including socio-demographic data, co-morbidities, clinical presentations, risk factors, complications, and outcomes were obtained. Necessary laboratory investigations including renal function test, serum electrolyte, and stool examination were done in Yekatit-12 Hospital.

Data processing and statistical analysis:

After checking for completeness, data were coded, entered, and analyzed using SPSS version 25 software package. Descriptive statistics were used to calculate rates. Multiple logistic regression analysis was used to check for association of dependent variable with independent variables. A p value < 0.05 was taken as statistically significant.

Results:**Demographic characteristics of patients with suspected cholera:**

From all 176 acute watery diarrheal patients suspected of cholera and admitted to the Cholera treatment center (CTC), females accounted for about 52.0% ($n=91$), over 45.0% had no formal education or educated only up to elementary school, and about one third of the patients had monthly income of less than 5000 Ethiopian Birr (Table 2).

About 93.0% of patients were from Addis Ababa, and the remaining 7.3% were referred from outside Addis Ababa. The suspected cases of cholera were from all the 11 sub-cities of Addis Ababa, with over 46.0% from Arada, Yeka, and Lemikura sub-cities in descending order (Fig 1). Only 16.7% of adults were living alone, and about 40.0% of patients were living in a family size of 5 and above.

Table 2: Demographic characteristics of patients with acute watery diarrhea admitted to the Cholera Treatment Center (CTC), Addis Ababa, Ethiopia

Characteristics		Number	Percentage (%)
Age group (years)	<15	19	10.8
	15-45	79	44.9
	>45	78	44.3
Sex	Male	85	48.3
	Female	91	51.7
Marital status	Single	60	34.1
	Married	85	48.3
	Widowed and divorced	31	17.6
Level of education	No formal education	35	19.9
	Preschool children	15	8.5
	Elementary	45	25.6
	High school	65	36.9
	College and above	16	9.1
Religion	Orthodox Christianity	135	76.9
	Protestant Christianity	29	16.5
	Muslim	9	5.1
Residence	Addis Ababa	161	91.5
	Outside Addis Ababa	15	8.5
Ethnicity	Amhara	78	44.3
	Oromo	36	20.5
	South Ethiopia	51	29
	Others	9	5.1
Income (Et Birr)	<1000	11	6.3
	1000-4999	43	24.4
	5000-10000	49	27.8
	>10000	4	2.3

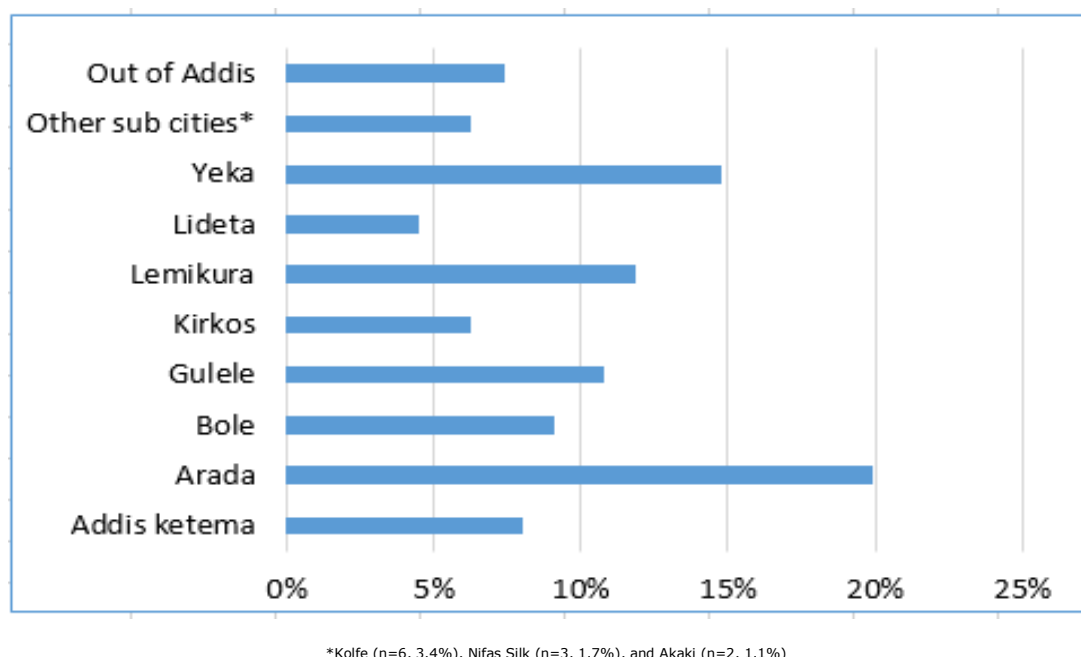


Fig 1: Distribution of acute watery diarrhea patients suspected of cholera in Sub-cities of Addis Ababa, Ethiopia

Clinical characteristics and management of patients with suspected cholera:

In the study setting, the outbreak of cholera was declared (1,17,18,25) and substantiated by microbiological evidence from the stool of patients with AWD. Subsequent assessment of cholera among over 90.0% of patients presented with AWD was made according to the case definitions as there was lack of diagnostic facilities. The major presenting symptoms among the AWD patients admitted were watery diarrhea in 27.7% of cases, and the remaining over 90.0% of patients had both watery diarrhea and vomiting of ingested matter. About 44.0% of patients had 1 day and/or less duration of illness at presentation, whereas about a quarter of patients had more than 3 days of illness at presentation. About half of the patients had an admission diagnosis of AWD with some DHN, and 36.7% of patients had AWD with severe DHN (Table 3).

Since early diagnosis and rapid management of dehydration are crucial among AWD patients suspected of cholera, all the patients admitted to the CTC had received generous fluid therapy. Oral rehydration salt (ORS) was given to all patients with No Dehydration (AWD with No DHN), and patients with some dehydration (AWD with Some DHN). ORS was also given for patients with severe dehydration (AWD with Severe DHN) whenever they can tolerate oral therapy. About 65% of patients received intravenous (Ringer's Lactate) fluid therapy; all patients with severe dehydration (AWD with Severe

DHN), and 49% of patients with some dehydrations (AWD with Some DHN) were given IV fluid up on the discretion of the treating physicians while monitoring their clinical condition.

About 88% of patients with severe DHN, and 50% with some DHN received antibiotics, mostly stat oral doxycycline of 300mg or IV antibiotics at the consideration of concomitant physician diagnosis of infections including sepsis, gastrointestinal infection, sepsis or chest infection. A third of patients developed hyponatremia, a quarter hypochloremia, and one-third of patients were treated with KCl for moderate or severe hypokalemia. About 75% of the patients had a hospital stay of at least 5 days (Table 3).

Factors associated with renal complications in patients with suspected cholera:

The mortality rate among patients with AWD suspected of cholera and admitted to the CTC was 6.25% (Table 3). All patients who died in the CTC had acute kidney injury (AKI) and 90.1% of them had an admission diagnosis of AWD with severe DHN or shock. Over 38% of AWD patients admitted to CTC developed acute kidney injury (AKI).

The risk of developing AKI was significantly increased with increased age, electrolyte disturbance, and level of dehydration. The risk of AKI among older patients aged above 45 years of age was 5.9 times higher than younger patients aged less than 15 years (95% CI: 1.501-23.3, $p=0.01$). Patients staying longer than 3 days in the hospital had 3.8 times higher

risk of AKI (95% CI: 1.8-8.05, $p=0.001$), and patients with severe dehydration had 3.96 times higher risk of AKI compared with patients no dehydrations (95% CI:1.205-13.018, $p=0.023$)

(Table 4). Although the burden of AKI was higher among females, and patients with co-morbidities, the differences were not statistically significant.

Table 3: Clinical characteristics of patients with acute watery diarrhoea admitted to the Cholera Treatment Center in Addis Ababa, Ethiopia

Clinical characteristics	Parameters	Frequency	Percent
Confirmed cholera	Confirmed cholera by stool examination	13	7.3
	Clinical diagnosis of cholera	164	92.7
Major symptoms	Watery diarrhea	49	27.7
	Watery diarrhea and vomiting	127	71.8
Duration of illness at presentation	<2 days	54	43.9
	2-3 days	40	32.5
	>3 days	28	22.8
Admission diagnosis with respect to dehydration	AWD with No Dehydration	21	11.9
	AWD with Some Dehydration	90	50.8
	AWD with Severe Dehydration	65	36.7
Treatment	Oral Rehydration Salt (ORS)	176	100
	Ringer's Lactate	115	65.3
	Antibiotics	103	58.5
	Potassium Chloride (KCL)	55	31.3
Comorbidities (Known history)	No co-morbidity	111	62.7
	Diabetes	22	12.5
	Hypertension	44	25
	HIV	12	6.8
	Others*	30	17
Duration of Hospital Stay	<3days	50	28.4
	3-5days	82	46.6
	>5days	39	22.2
Acute kidney Injury	No	61	34.5
	Yes	68	38.4
	Incomplete data	48	27.1
Hypokalemia	No	80	45.2
	Yes	81	45.8
	Mild (3.4-3.0mEq/L)	22	12.2
	Moderate (2.5-2.9mEq/L)	28	15.8
	Severe (<2.5mEq/L)	31	17.5
	Incomplete data	16	9.0
Hyponatremia	No	100	56.5
	Yes	61	34.5
	Mild (130-134mEq/L)	35	19.8
	Moderate (125-129mEq/L)	17	9.5
	Severe (<125mEq/L)	9	5.1
	Incomplete data	16	9.0
Hypochloremia	No	110	62.1
	Yes (<96mEq/L)	42	23.7
	Incomplete data	25	14.5
Outcomes	Resolved	163	93.7
	Died	11	6.25

*Old stroke, malignancy, bronchial asthma, psychiatric illness, seizure; AWD = Acute watery diarrhoea

Table 4: Factors associated with renal complications in patients with acute watery diarrhea admitted to Cholera Treatment Center of Yekatiti-12 Hospital Medical College, Addis Ababa, Ethiopia

Clinical characteristics		No AKI (%)	AKI (%)	AOR	95% CI	p value
Age group (years)	<15	12 (80.0)	3 (20.0)			1
	15-45	26 (45.6)	31 (54.4)	4.76	1.214-18.7	0.025*
	>45	23 (40.4)	34 (59.6)	5.9	1.501-23.3	0.01*
Comorbidity	No co-morbidity	44 (51.8)	17 (48.7)			1
	Comorbidity	17 (38.6)	27 (61.4)	1.7	0.812-3.57	0.15
Sex	Female	32 (53.5)	28 (46.7)			1
	Male	29 (42.0)	40 (58.0)	1.5	0.78-3.1	0.2
Length of stay	<3 days	38 (65.5)	20 (34.5)			1
	≥3 days	22 (33.3)	44 (66.7)	3.8	1.8-8.05	0.001*
Level of DHN	AWD with No DHN	11 (73.3)	4 (26.7)			1
	AWD with Some DHN	30 (52.6)	27 (47.4)	1.98	0.61-6.431	0.25
	AWD with Severe DHN	20 (35.1)	37 (64.8)	3.96	1.205-13.018	0.023*
Hyponatremia	No Hyponatremia	40 (54.4)	34 (45.5)			1
	Hyponatremia	20 (35.1)	37 (64.9)	1.85	1.45-27.83	0.014*
Hypochloremia	No Hypochloremia	47 (58.8)	33 (41.3)			1
	Hypochloremia	3 (9.7)	28 (90.3)	2.6	3.2-67.17	0.001*
Hypokalemia	No Hypokalemia	28 (49.1)	29 (50.9)			1
	Hypokalemia	25 (41.0)	36 (59.0)	1.34	0.925-15.9	0.06

AKI=Acute kidney injury; DHN = Dehydration; AWD= Acute watery diarrhea; AOR = Adjusted Odd Ratio; CI=Confidence Interval

Factors associated with renal complications in patients with suspected cholera:

The mortality rate among patients with AWD suspected of cholera and admitted to the CTC was 6.25% (Table 3). All patients who died in the CTC had acute kidney injury (AKI) and 90.1% of them had an admission diagnosis of AWD with severe DHN or shock. Over 38% of AWD patients admitted to CTC developed acute kidney injury (AKI). The risk of developing AKI was significantly increased with increased age, electrolyte disturbance, and level of dehydration.

The risk of AKI among older patients aged above 45 years of age was 5.9 times higher than younger patients aged less than 15 years (95% CI: 1.501 - 23.3, $p=0.01$). Patients staying longer than 3 days in the hospital had 3.8 times higher risk of AKI (95% CI: 1.8-8.05, $p=0.001$), and patients with severe dehydration had 3.96 times higher risk of AKI compared to patients with no dehydration (95% CI: 1.205-13.018, $p=0.023$) (Table 4). Although the burden of AKI was higher among females and patients with comorbidities, the differences were not significantly different ($p>0.05$).

Frequency of risk factors for acute watery diarrhea in patients with suspected cholera:

Of all the AWD patients suspected of cholera and admitted to CTC of yekatiti-12 Hospital Medical College, 76.7% of patients did not have the preceding overt contact history to diarrheal patient, 80.1% did not have attendance to soc-

ial gathering, 92.6% did not have travel history in the preceding 10 days, and about 87% did not have similar history in the family. However, 54% had history of eating foods outside of home, 81.3% had history of eating raw fruits and vegetables, about 80% drunk water stored for over 3 days and not chlorinated or boiled (Table 5).

Discussion:

Frequent outbreaks of cholera continue to be one of the major public health problems in low-and-middle-income countries (LMICs) including Ethiopia where water, sanitation, and hygiene (WaSH) are inadequate (12). In this study, 176 patients with acute watery diarrhea suspected to have cholera were admitted to the cholera treatment center (CTC) at Yekatiti-12 Hospital Medical College, of which females accounted for about 52%, and 90% were at least 15 years of age. The age-specific attack rate was highest in the most productive age group of 15-44 years, which is consistent with different studies in Ethiopia (13,22) and beyond (23,24,26, 27,28,29,30).

The current outbreak occurred during the rainy season and involved all sub-cities of Addis Ababa. A similar pattern was also documented in previous episodes of the outbreaks in the capital (22). Due to the widespread outbreak of cholera across the regional states of Ethiopia (14,25) and the continuous flux of people to Addis Ababa from regional states, infections

Table 5: Frequency of common risk factors for acute watery diarrhoea among patients admitted to the Cholera Treatment Center of Yekatiti-12 Hospital Medical College, Addis Ababa, Ethiopia

Characteristics of risk factors		Frequency	Percentage (%)
Contact with diarrheal patient	No	135	76.7
	Yes	40	22.7
Prior attending of social gathering	No	141	80.1
	Yes	35	19.9
Prior travel history within 10days	No	163	92.6
	Yes	13	7.4
Similar history in the family	No	153	86.9
	Yes	23	13.5
History of eating food outside home	No	81	46.0
	Yes	95	54.0
Eating raw fruits and vegetables	No	12	6.8
	Yes	143	81.3
Where do you shop fruits and vegetables	Market	122	69.3
	Roadside	32	18.2
Common source of drinking water	Household tap water	107	60.0
	Municipality tap water	46	26.1
	Well water	21	11.9
	Bottled water	2	1.1
Storing drinking water in the container	No	28	15.9
	Yes	147	83.5
How frequent you get pipe water	<3days	21	11.9
	3-5days	94	53.4
	>5days	40	22.7
Chlorination or boiling of drinking water	No	150	85.2
	Yes	20	11.4
Type of toilet	No toilet	14	8.0
	Communal toilet	52	29.5
	Separate toilet	109	61.9
Type of latrine	Pit latrine	149	84.7
	Indoor toilet	12	6.8
Water and soap in the toilet for cleaning purpose	No	87	49.4
	Yes	75	42.6
Hand washing practice with soap after the toilet	No	10	5.7
	Yes, Some times	61	34.7
	Yes, always	94	53.4

might have been transmitted to the capital city. More than half of patients admitted to cholera treatment center had low level of education and low socio-economic status, consistent with the high burden of similar faeco-oral diseases among under privileged low socioeconomic population of the communities of Addis Ababa (9).

In the current study, the major symptoms among patients with AWD admitted to the CTC were watery diarrhea in 27.7%, and over 90% had both watery diarrhea and vomiting of ingested matter. This is consistent with previous data from Ethiopia (9,19,22), and cholera studies in other countries (21,26). Only 11.9% of the patients with AWD had an admission diagnosis

of no dehydration while about half of the patients were diagnosed with some dehydration, and 36.7% had severe dehydration. Severity of dehydration observed in our study is similar to those reported in studies from Ethiopia (13,22), Iran (26), Pakistan (27), and Zambia (28). However, cases of severe dehydration were higher in our study than other studies from Ethiopia (19), and Iran (21), which may be due to the delayed presentation of patients, and only those patients with marked symptoms might have sought medical attention, which is consistent with the low health seeking behavior in the region.

Cholera is characterized by a devastat-

ing watery diarrhea which leads to rapid dehydration and death in 50 - 70% of untreated patients (27,29). Therefore, prompt and adequate rehydration is the corner stone of therapy for such acute water diarrheal patients (2,4). Oral rehydration salt (ORS) was given to patients with no dehydration, some dehydration, and also patients with severe dehydration while triaging and assessing the level of dehydration as well as during recovery phase. All patients with severe DHN were also given intravenous fluid of ringer's lactate, and antibiotics, which is consistent with similar reports (27,29). Unless for the treatment of sepsis including hospital acquired pneumonia on the discretion of the treating physician, 300mg stat dose of oral doxycycline was the antibiotic of choice to decrease the duration of illness and the period of infectiveness (4).

Many studies have reported that antibiotic therapy shortens the diarrheal duration by about a day, reduces the total stool volume by 50%, reduces the amount of rehydration fluids required by 40%, and reduces the mean duration of fecal excretion of bacteria by almost 3 days (2). Although intravenous fluids and antibiotics were reserved for patients with severe dehydration and/or some dehydration with profound fluid loss (2,4,29), significant number of patients with no dehydration were also given IV fluids, which contradicts the recommendations. The high mortality rate in cholera and renal as well as electrolyte complications might have influenced the choice of the treating physicians to adopt this aggressive approach.

In our current study, the proportion of acute kidney injury among AWD patients was 38.4%, and the risk of developing AKI was associated with increasing age ($p=0.02$), increased length of hospitalization ($p=0.01$), severity of dehydration ($p=0.017$), hyponatremia ($p=0.013$) and hypochloremia ($p<0.01$). The burden of AKI was similar to the finding in tertiary hospital of Pakistan (27) but much lower than the rate of 78% in Bangalore hospital in India, which might be due to limited number of cases, and severe disease in the latter setting where about 56.8% of patients had severe dehydration and over 90% had hypovolemic shock (30). We observed a significant electrolyte complication among the AWD patients admitted to CTC with hypokalemia, hyponatremia and hypochloremia in 45.8%, 34.5% and 23.7% of patients, respectively, which is in alignment with similar studies (21, 31).

The mortality rate among patients with AWD admitted to the CTC was 6.25%, which is comparable with other studies in Ethiopia (18), Sudan (32), and Syria (21). However, it is much

higher than other retrospective studies in Ethiopia (13,19,22). The study design that reports actual real time burden as opposed to passively collected retrospective data (13,19,22), delayed presentation of patients to the referral center, severity of illness at presentation such as severe DNH or shock and AKI, and the presence of comorbidities might have contributed to the increased mortality in our study. The inaccessibility of hemodialysis for some of the critical patients with uremic complications might have also compounded the problem.

Cholera, a faeco-oral disease transmitted by consumption of contaminated food or drink, is one of the key indicators of poor socio-economic development and remains a challenge to countries where access to safe drinking water and adequate sanitation cannot be guaranteed. Consistent with the notion that most of the cholera patients (80%) are asymptomatic but can transmit the infection (22), only 22.7% of our patients had overt contact with diarrheal patient and about 15% of patients had similar illness in the family. However, 54% of our patients' consumed fruits and vegetables which were commonly grown around the unhygienic rivers of the heavily populated Addis Ababa city where most of the household sewerage lines terminate (22). Astonishingly, about 90% of patients obtained their drinking water at most twice a week, and therefore utilize stored drinking water for days with only about 10% using chlorination or boiling before drinking. This finding is consistent with other similar studies in Ethiopia (9,17). Similarly, about 85% of our patients had shared pit latrine, 50% had no water and soap in the toilet for hand washing, and 40% do not practice hand washing or only sometimes wash their hands after using toilet. The extent of poor sanitation in the current setting is better than report from rural Ethiopia (18), but comparable with the study in Addis Ababa (9).

The main limitation of the study is its small sample size from a single center, which makes it difficult to generalize the result to the broader population. The cross-sectional design of the study can only establish associations and not cause-effect relationship between the predictors and the outcome variables. Due to financial constraints and lack of easy availability, some patients did not have laboratory panels including laboratory confirmation of cholera.

Conclusion:

The cholera outbreak in Addis Ababa, Ethiopia was characterized by moderate to severe dehydration, high burden of electrolyte imbalance, acute kidney injury and high case fata-

lity rate. Community WaSH intervention, early case detection, and coordinated management strategies play key roles in reduction of disease burden, morbidity and mortality.

Contributions of authors:

MM conceived the study, supervised the study, did the statistical analysis and interpretation, Written the manuscript, MR did statistical analysis, revised the manuscript. GC participated in data collection, did statistical analysis, and revised the manuscript. All authors approved the final version of the manuscript.

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Authors declare no conflict of interest.

Data availability:

Individual data will not be made publicly available for privacy protection. De-identified participant data will be shared upon reasonable request.

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