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ORIGINAL ARTICLE

Factors influencing access to advanced sanitation service level and drinking-water quality in healthcare facilities in Addis Ababa, Ethiopia: a convergent sequential study

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Abstract
This study investigates factors influencing access to advanced sanitation services and drinking water quality in healthcare facilities (HCFs) in Addis Ababa, Ethiopia. Despite the critical role of sanitation and safe water in preventing healthcare-associated infections, many facilities face significant challenges. A convergent sequential study was conducted in 382 healthcare facilities, which involved observations of sanitation facilities, interviews with facility managers, and water quality tests of 382 samples. Additionally, five water samples from reservoirs and distributors were collected, and eight key informant interviews were conducted purposively. In this investigation, only 14.5% of healthcare facilities had advanced sanitation service, while 23.2% had basic sanitation services. Over half (62.3%) of the facilities provided limited sanitation services. Additionally, 22.7% of water samples tested positive for *enterococci*, 26% for *Escherichia coli*, 35% for *fecal coliforms*, and 38.8% for *total coliforms*. All samples analyzed for fluoride, conductivity, and total dissolved solids (TDS) were below permissible limits, except for 6.6% of the samples that exceeded the pH level of 8.5. In contrast, all water samples from reservoirs and distributors were free from bacterial contaminations, and their fluoride, conductivity, and TDS levels were within the standard. Factors such as having infection prevention committee (IPC)(AOR = 2.8, 95% CI: 1.07-7.52), trained managers on sanitation safety plan (AOR = 2.96, 95% CI: 1.10-7.94), managers trained in infection prevention (AOR = 3.6, 95% CI: 1.25-10.48), having sanitation standards (AOR = 3.5, 95% CI: 1.06-11.64), availability of sufficient budget for sanitation services (AOR = 3.2, 95% CI: 1.14-9.15), having specific annual sanitation plan (AOR = 3.6, 95% CI: 1.52-8.58), using updated WASH guidelines (AOR = 3.4, 95% CI: 1.05-11.20), absence of a sanitation safety plan (AOR = 0.22, 95% CI: 0.05-0.91), lack of regular monitoring and evaluation (AOR = 0.24, 95% CI: 0.07-0.83), and managers who did not involve in leading renovation of WASH infrastructure (AOR = 0.56, 95% CI: 0.35-0.70) were significantly associated with access to advanced sanitation service level. Access to advanced and basic sanitation services is low in HCFs of Addis Ababa. Several core factors affecting access to advanced sanitation service level has been identified. Many water samples from healthcare facilities were contaminated by bacteria. Enhancing training programs for healthcare managers and securing adequate funding are critical steps toward improving sanitation and water quality.

Keywords Sanitation · Water quality · Factors · Healthcare · Addis ababa

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Introduction

Access to advanced sanitation and safe water services in healthcare facilities are fundamental for delivering quality medical care (Watson et al. 2019). Aligned with Sustainable Development Goal (SDG) 6, which aims to ensure the availability and sustainable management of water and sanitation for all (Too 2017), advanced sanitation services and the provision of quality water in healthcare facilities are essential for minimizing the risk of healthcare-associated infections

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and enhancing patient safety (Jeddi et al. 2022). In many regions, poor access to advanced sanitation and inadequate water supply services compromise medical procedures and lead to an increase in infectious diseases (Hutton et al. 2024). On the other hand, establishing strong sanitation systems and ensuring reliable access to clean water safeguard patients from diseases and aid healthcare workers in delivering effective care (Biswas et al. 2020; Joshi et al. 2018). By prioritizing improvements in sanitation services and water quality (Montoya et al. 2025), healthcare systems can foster a safer environment, reduce costs associated with preventable diseases, and contribute to the overall sustainability of health services (Ugwu et al. 2025). Access to advanced sanitation and clean water services enhances public health initiatives by protecting individual patients and healthcare workers while reducing the overall prevalence of infectious diseases in the community (World Health Organization and UNICEF 2017). Safe sanitation and clean water services are vital for protecting health, keeping disease-carrying waste and insects away from people in healthcare facilities and their surroundings (Inabo and Arshed 2019; Ogunbode et al. 2025). The World Health Organization (WHO) emphasizes that safe sanitation and clean water are crucial for infection control, particularly in settings caring for vulnerable populations, such as mothers and newborns (World Health Organization 2022). Evidence shows that a lack of access to sanitation and quality water significantly compromises safe childbirth and access to primary healthcare (World Health Organization 2019a). Each year, over one million deaths are associated with unclean births, with infections accounting for 26% of neonatal deaths and 11% of maternal mortality (World Health Organization 2019d). Alarmingly, more than 21% of healthcare facilities worldwide rely on unimproved sanitation facilities or lack any latrine facility at all, and only 23% of healthcare facilities in Sub-Saharan Africa have basic sanitation services (World Health Organization). Consequently, inadequate sanitation services jeopardize the safety and quality of healthcare, posing significant risks to health providers and patients (Bouzid et al. 2018). The impact of low access to advanced water and sanitation services in healthcare facilities is particularly severe for maternal and newborn health. Worldwide, mothers are encouraged to deliver in healthcare settings; however, according to the 2025 JMP report, approximately 46% of global newborn deaths and 70% of maternal deaths occur in sub-Saharan Africa, where only 60% of healthcare facilities have access to basic water services (World Health Organization 2025). Recent global estimates indicate that maternal and newborn deaths remain alarmingly high, with a combined total of 2.5 million fatalities and a significant slowdown in progress toward preventing these deaths over the past decade (World Health Organization 2023). Despite SDG 6's target of achieving universal access to basic sanitation services by 2030, significant gaps remain in healthcare facilities (Kayiwa et al. 2020). The 2020 Joint Monitoring Programme (JMP) progress report indicated that 63% of healthcare facilities globally had no sanitation services (World Health Organization 2020a). Furthermore, more than three-fourths of healthcare facilities in Sub-Saharan African countries lack basic sanitation services (World Health Organization 2019b). A credible report by the JMP indicated that billions of people lack access to adequate sanitation services, essential for preventing infections and promoting a higher quality of life (Sadhu et al. 2022). Globally, 25% and 20% of healthcare facilities lack basic water and sanitation services, impacting over 1.5 billion and 2 billion people, respectively (Organization 2019c). In African healthcare, the sanitation and water crisis is alarming. In Sub-Saharan African countries, including Ethiopia, 77% of the healthcare facilities had no basic sanitation services (World Health Organization 2019b). These deficiencies compromise the quality of care, leading to increased risks of healthcare-associated infections and poor health outcomes, particularly in maternal and child health services (Mcconville et al. 2020). Poor sanitation services and contaminated water, in particular, lead to significant health problems (Abdipour et al. 2025; Mohamed et al. 2025). Despite the importance of advanced sanitation and water services for health, welfare, dignity of patients, child development, and social progress (Okesanya et al. 2024), lack of access to these services remains a critical issue in healthcare facilities, directly influencing health outcomes, economic stability, and social equity (Yulianti and Meutia 2023). Access to sanitation and clean water suffers from chronic under-prioritization, lack of leadership, underinvestment, and insufficient capacity (GLOBAL 2019). While many countries have national policies to support water and sanitation services, few have allocated adequate human and financial resources to ensure safety (Chotchoungchatchai et al. 2020). According to a recent JMP report, 45% and 22% of Ethiopian healthcare facilities do not have water and sanitation services, respectively (World Health Organization and Fund 2025). However, factors affecting access to these services have not been studied in depth. Therefore, it is important to explore the factors affecting access to advanced sanitation and clean water services among healthcare facilities.

Methods

Study area

The study was conducted in the Addis Ababa city administration, which has an estimated population of 3.65 million people (Alemu and Dioha 2020). According to the Addis Ababa Food, Medicine, Health Care Administration, and Control Authority unpublished report of 2020, 1,957 governmental and private healthcare facilities exist. However, this number includes pharmacies and drug stores, which are very numerous. For this study, we compiled an updated list of 845 healthcare facilities (HCFs) from each sub-city of the Addis Ababa Food and Drug Authorities, including four federal referral hospitals and six regional governmental hospitals. The location map of the study site and sampling points is shown in Fig. 1.

Study design and period

A convergent sequential study was conducted from June 2024 to March 2025 among HCFs of Addis Ababa, Ethiopia. A convergent sequential study is a research design that combines qualitative and quantitative methods to provide a fuller understanding of a topic. In this convergent sequential study, data collection was collected concurrently.

Source population

All (845) healthcare facilities located in the Addis Ababa city administration were the source population.

Study population

For the quantitative data, 382 randomly selected healthcare facilities were included. From these facilities, the sanitation facilities were evaluated for service level and facility manager was interviewed. Additionally, 382 water samples were included from each of the HCFs selected for this study. Furthermore, 5 drinking water samples were included from the Addis Ababa city administration's main reservoirs and distributors. These reservoirs are the sources of water for all the sub cities of the Addis Ababa city administration, except for a few districts in Akaki and Nifas Silk subcity. In addition, 8 healthcare managers/infection prevention heads were included as study participants for the qualitative study.

Inclusion criteria

The inclusion criteria included all healthcare facilities located in Addis Ababa city administration. However,

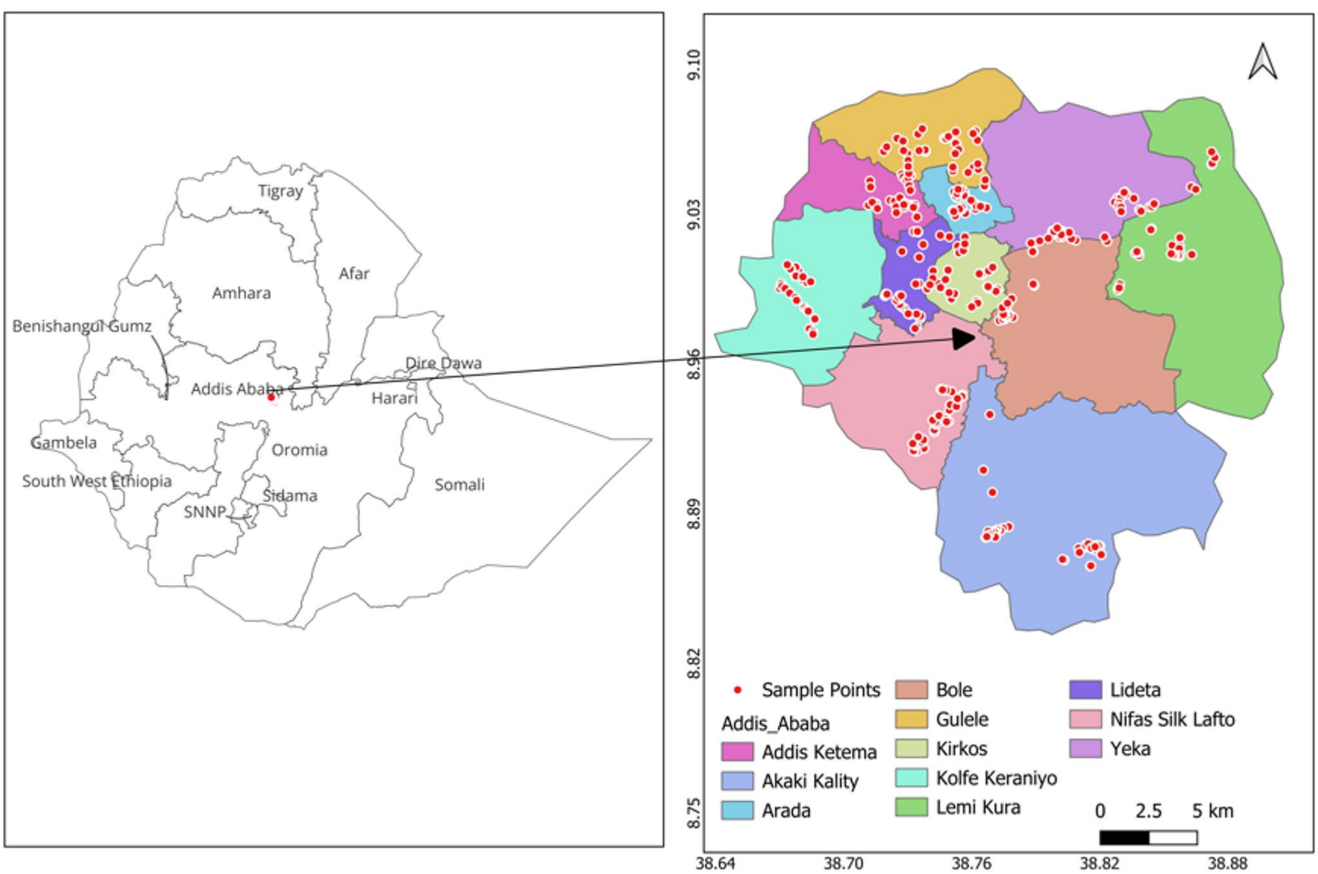

Fig. 1 Location map of the study site

healthcare facilities that were not operational and healthcare managers on annual or maternity leave were excluded from the study.

Sample size determination

The sample size was determined using a single population proportion formula, relying on these assumptions: a 95% confidence interval (CI), a 5% margin of error (e), a design effect of 2 (def), and data from the WHO 2012 report, which indicated that 13% of healthcare facilities (P) did not have clean water supply services (ANNEX 2012).

Then,

$$\mathrm{n} = \frac{(\mathrm{Z}^2) \times \mathrm{P}\ \ (1-\mathrm{P})\,\mathrm{def}}{\mathrm{e}^2}$$

$$\mathrm{n} = \frac{(1.96)\ \times (1.96)\ \ \times\ \ (0.13)\ \ \times\ \ (1-0.13)\,2 =\ 347}{0.05 \times 0.05}$$

Including a 10% adjustment for the nonresponse rate, a total of 382 healthcare facilities were included in the study. Hence, sanitation services from each of the facilities were observed, 382 HCFs managers were interviewed, and 382 water samples were collected for laboratory analysis.

Sampling procedure

The study employed a stratified simple random sampling technique to select participants. To determine the 382 healthcare facilities included in the study, we categorized the facilities based on the types of services they offer. This approach ensured that the sample accurately represented the various types of healthcare services available in the region. In addition, to ensure sample representativeness, a proportional sample allocation was conducted. In the first stage, we obtained a new list of healthcare facilities from each sub-city of the Addis Ababa Food and Drug Authorities, resulting in a total of 845 facilities. Sample allocation was then conducted for each sub-city. In the second stage, the evaluation of sanitation services included the observation of 382 healthcare facilities; interviews with one manager from each facility, and the collection of 382 water samples. Water samples were collected from the tap water of the healthcare facilities. The collected water samples were analyzed in the laboratory for bacteriological and physicochemical characteristics. For drinking water sample collection, 250 ml heat-sterilized bottles were used for bacteriological testing, while 1,000 ml plastic bottles were utilized for physicochemical analysis. The sampling and analysis techniques were adapted from the 1998 Standard Methods for Examining Water and Wastewater, developed by the United States Food and Drug Administration and the American Public Health Association/American Water Works Association/Water Environment Federation (American Public Health Association 1998a, b; Food and Administration 2002). Each healthcare facility was assigned a unique code number, which was indicated in the questionnaire and labeled on the container of each water sample tube. The bottles were delivered to the laboratory within 6 h and stored in a refrigerator at 4 °C until analysis. For the qualitative data, a total of 8 key informants were included to identify policy, administrative, and capacity gaps affecting WASH services. These included 3 informants from medium clinic, 1 Internal Medicine Specialty centers, 1 from dental clinic, 1 Internal medicine specialty clinic, 1 from health center, and 1 informant from Hospitals. They were selected through purposive sampling based on their proximity and responsibilities related to WASH services at the healthcare facilities.

Data collection procedures

For the quantitative data collection, five health professionals with Bachelor of Science degrees and extensive experience in data collection were hired. Additionally, two Master's degree holders served as supervisors. To maintain consistency in the collection process, both data collectors and supervisors participated in two days of training. After securing written consent from each healthcare manager, data were gathered using Open Data Kit (ODK). The collection involved face-to-face interviews with healthcare managers, utilizing a structured questionnaire adapted from existing literature ADDIN EN.CITE (Abu et al. 2021; Girmay et al. 2023; Watson et al. 2019; Weber et al. 2018). For qualitative data collection, additional one experienced data collector was hired. The purpose of hiring an experienced data collector for qualitative data collection is to ensure high-quality and reliable data. To collect qualitative data concurrently, face-to-face interviews were conducted with 8 purposively selected key informants using semi-structured interview guide. The key informant interview was recorded using audiotape recorder. To determine the healthcare WASH challenges, an open discussion was held with key informants to explore their experiences until saturation was reached.

Data quality control

A standardized questionnaire was designed and utilized based on WHO guidelines and relevant literature. To ensure the consistency of questions, an English questionnaire was translated into Amharic and retranslated into English. Data quality was maintained through training for data collectors, continuous monitoring, prompt feedback, and daily rechecking of completed questionnaires. Additionally, a daily activity evaluation approach was implemented to address any challenges during data collection. Consent was obtained for each study, and confidentiality was assured. The reliability of clinical water quality data was upheld by trained laboratory personnel who followed all relevant procedures. The instruments and reagents used for water quality tests were calibrated, and the expiration dates of the reagents were verified. To enhance the quality of qualitative data, key informants were encouraged to express their ideas and opinions freely and to share their experiences regarding healthcare WASH services.

Data analysis

Every data point was reviewed for information and code correctness. SPSS (Statistical Package for the Social Sciences) version 26 was used to analyze quantitative data. Descriptive statistics, Binary Logistic Regression, and Multivariable Logistic Regression were conducted to identify significant predictors for advanced sanitation service level. A p-value of less than 0.05 was considered statistically significant in all analyses. Thematic analysis was performed for the qualitative data. First, the audio-recorded data was transcribed and translated into English. The text data was stored and organized using qualitative data management software, NVivo software. Then, the data was organized by generating initial codes and identifying main themes. Finally, the main themes were explained with quotes from key informants' opinions and experiences regarding healthcare WASH barriers. Four experienced laboratory professionals were used to analyze bacteriological and physicochemical parameters.

Bacteriological analysis

The membrane filtration method was used to identify *enterococci*, *total coliforms*, *fecal coliforms*, and *Escherichia coli (E. coli)*. In this study, 100 mL water samples were filtered through membranes with a pore size of 0.45 µm. The membranes were then incubated on agar plates, allowing bacterial cells trapped on the membranes to grow into countable colonies, facilitating the calculation of bacterial density. For *total coliform* detection, the cells were incubated at 37 °C for 24 h, after which the *total coliform* count was determined. For *fecal coliform* detection, the same 100 mL water samples were filtered using 0.45 µm cellulose nitrate membranes (Millipore, USA). The filters were aseptically placed on Eosin Methylene Blue (EMB) agar (Himedia) and incubated at 44.5 °C for 24 h. To isolate *E. coli*, the same filtration method was applied. After incubation, positive samples were re-inoculated into peptone broth test tubes for 24 h at 44.5 °C, followed by the addition of Kovac's reagent. Test tubes that exhibited a reddish color at the top were considered positive for *E. coli*. To enumerate intestinal *enterococci*, the 100 mL water samples were filtered again through a 0.45 µm membrane. The filter was placed on a selective medium containing sodium azide (to inhibit Gram-negative bacteria) and 2,3,5-triphenyltetrazolium chloride, which intestinal *enterococci* reduce to red formazan. If typical colonies developed a red, maroon, or pink color, a confirmation step was performed by transferring the membrane to bile-aesculin-azide agar, preheated to 44 °C. After 2 h, if *enterococci* were present, the product 6,7-dihydroxycoumarin combined with iron (III) ions to form a tan to black compound that diffused into the medium.

Physicochemical analysis

Each sample was analyzed according to the protocols specified in the Standard Methods for the Examination of Water and Wastewater (American Public Health Aassociation) as follows. Fluoride concentrations were determined using a Jenway 3345 bench ion-meter paired with an ion-selective electrode (Orion ISE 9409). All reagents were of analytical grade, and ultra-pure water was used for preparation. To prevent contamination, all polyethylene and glassware were pre-soaked overnight in a 5% nitric acid solution. To adjust ionic strength, stabilize pH, and minimize interferences from polyvalent cations, a Total Ionic Strength Adjustment Buffer (TISAB) was prepared, consisting of 58 g NaCl, 57 mL glacial acetic acid, 4 g 1,2-cyclohexanedinitrilo-tetraacetic acid (CDTA), and 150 mL of 6 Molar NaOH, making a total volume of 1,000 mL (pH 5.0-5.5). A stock fluoride standard solution of 1,000 mg/L (Mettler Toledo®) was used to prepare a 100 mg/L intermediate standard, from which a series of calibration standards (0.1, 0.3, 1.0, 3.0, and 10.0 mg/L) were created through serial dilution with ultra-pure water. The fluoride ion-selective electrode was calibrated using a five-point standard, with the ion meter automatically adjusting the slope value to -59 mV. Additionally, aggregate parameters, such as conductivity and total dissolved solids (TDS), were measured using a portable conductivity meter (SX713 Cond/TDS/Sal/Res Meter), while pH was assessed with a portable pH meter (PH-P310F, Infitek).

Definitions

Healthcare facility Means any governmental and nongovernmental private institutions including diagnostic stations that carryout promoting preventive curative and rehabilitative activates or medicine trade or services.

Healthcare managers In this study, healthcare managers are defined as individuals who oversee and manage the operational aspects of a healthcare organization or department to ensure efficient and effective patient care. They are responsible for managing resources, staff, finances, and administrative functions to support healthcare goals and deliver quality services.

Drinking water quality According to WHO drinking water standard 2004, water samples with <1 CFU/100 ml were considered to be uncontaminated and samples with ≥1 CFU/100 ml to be contaminated (World Health Organisation 2004). Water samples with ≤ 1.5 mg/liter concentration of fluoride values was considered free from contamination. However, water samples having >1.5 mg/liter concentration values of fluoride will be considered contaminated, respectively ADDIN EN.CITE (World Health Organization 2011; Girmay et al. 2021; World Health Organization 2021). In addition, according to the Ethiopian Standards Agency's Compulsory Standards First Edition, Drinking Water Specifications (2013), samples with pH values between 6 and 8.5 and Total Dissolved Solids (TDS) levels below the maximum permissible limit of 1,000 mg/L were categorized as acceptable (Agency 2013). The limit for electrical conductivity in drinking water is generally set at 500 microsiemens per centimeter (µS/cm) by the World Health Organization (WHO) and other sources for aesthetic purposes (Do 2017; World Health Organization 2011; Scientific 2024). However, for health-related guidelines, levels can be higher but should ideally not exceed 1,500 µS/cm to avoid potential health risk. However, this study taken 1,500 µS/cm as a cut of point(Ayana 2019; Edition 2011).

Table 1 JMP ladders for sanitation service levels in healthcare facilities

Sanitation service ladders	
Advance service	Improved sanitation facilities are usable with at least one toilet dedicated to staff, at least one sex-separated toilet with menstrual hygiene facilities, and at least one toilet accessible for people with limited mobility. Furthermore, the toilet facilities should be clean, have lighting, and have a sufficient number of toilets (one per 20 users for inpatient settings; at least four toilets per outpatient setting-one for staff and patients: one for females, one for males, and one toilet accessible for people with limited mobility) should be available.
Basic service	Improved sanitation facilities are usable with at least one toilet dedicated to staff, at least one sex-separated toilet with menstrual hygiene facilities, and at least one toilet accessible for people with limited mobility.
Limited service	At least one improved sanitation facility, but not all requirements for basic service are met.
No service	Toilet facilities are unimproved (pit latrines without a slab or platform, hanging latrines, and bucket latrines), or there are no.

Sanitation service level determination

Sanitation service levels were evaluated based on the UNICEF/WHO Joint Monitoring Program (JMP) (https://washdata.org/monitoring/health-care-facilities) as shown in Table 1.

Results

Description of HCFs

To evaluate sanitation service level observationally, this study includes different healthcare facilities, such as an Internal Medicine Specialty Center, a General Hospital, an Internal Medicine Specialty Clinic, a Primary Clinic, a Health Center, a Medium Dental Clinic, and a Medium Clinic. These facilities represent a diverse range of services, from specialized care to general outpatient treatment, addressing various health needs within the community.

Socio-demographic characteristics of healthcare managers.

In this study, 366 out of 382 included healthcare managers participated, resulting in a response rate of 95.8%. The majorities (67.5%) of managers were men and 35.2% of them were aged over 43 years. Above half (67.8%) of managers had not received training on sanitation safety plans, and 68.9% had not been trained in infection prevention. Most (63.1%) of healthcare facilities lacked an effective WASH-FIT committee/infection. Additionally, 52.2% of facilities did not have a sufficient budget for sanitation services. Furthermore, 66.4% of managers were not organizing biannual training sessions on WASH services (Table 2).

Access to key sanitation services indicators among the healthcare facilities

Though over half of the assessed healthcare facilities belonged to the limited service category, all had at least one improved toilet. The majority (68.9%) of healthcare facilities had flush or pour-flush toilets connected to septic tanks or pits, 16.4% had toilets connected to sewer systems, and 14.8% utilized pit latrines with slabs. Almost all (97.3%) healthcare facilities had at least one usable toilet that was available, and functional. However, only 66.1% had a functional toilet dedicated to staff. Most facilities (59.8%) provided separate toilets equipped for menstrual hygiene needs. Additionally, 63.4% of facilities had accessible toilets for individuals with limited mobility. However, only 39.3% met

Table 2 Socio-demographic characteristics of healthcare managers and healthcare facilities of addis Ababa City administration (*n*= 366)

Study variables	Item category	Frequency	Percentage (%)
Age of managers in years	18-23	1	0.3
	24- 28	25	6.8
	29-33	54	14.8
	34-38	85	23.2
	39-43	72	19.7
	>43	129	35.2
Sex of healthcare managers	Male	247	67.5
	Female	119	32.5
Marital status of healthcare managers	Single	53	14.5
	Married	311	85.0
	Divorced	2	0.5
Healthcare facilities having effective WASH-FIT committee/infection prevention committee (IPC)	Yes	135	36.9
	No	231	63.1
Managers receiving training about sanitation safety plan	Yes	118	32.2
	No	248	67.8
Managers receiving training about infection prevention	Yes	114	31.1
	No	252	68.9
Healthcare facilities having focal person for sanitation services	Yes	281	76.8
	No	85	23.2
Healthcare facilities having sanitation standard or guideline	Yes	154	42.1
	No	212	57.9
Healthcare facilities having sufficient budget with specific budget line for sanitation services	Yes	172	47.0
	No	191	52.2
Healthcare facility having specific annual plan for sanitation services	Yes	122	33.3
	No	244	66.7
Healthcare facilities having updated WASH guideline	Yes	161	44.0
	No	205	56.0
Healthcare facilities having sanitation safety plan	No	179	48.9
	Yes	187	51.1
Healthcare facilities managers having practice of regular monitoring and evaluation on WASH services	No	201	54.9
	Yes	165	45.1
Healthcare facilities managers having active participation in renovation of WASH infrastructure	No	209	57.1
	Yes	157	42.9
Healthcare facilities having environmental health club/committee	Yes	251	68.6
	No	115	31.4
Healthcare facilities having managers organizing training at least biannually on WASH services	Yes	123	33.6
	No	243	66.4

the standard of having one toilet per 20 users in inpatient settings, and just 29.8% had at least four toilets per outpatient setting (Table 3).

Table 3 Access to key sanitation services indicators in healthcare facilities of addis Ababa City administration (*n*= 366)

Key sanitation service indicators of healthcare facilities	Item category	Frequency	Percentage (%)
Types of toilets/latrines in the healthcare	Flush/Pour-flush toilet to sewer connection	60	16.4
	Flush/Pour-flush toilet to tank or pit	252	68.9
	Pit latrine with slab	54	14.8
Had at least one toilet usable (available, functional, and private)	Yes	356	97.3
	No	10	2.7
Having at least one type of functional toilet dedicated for staff	Yes	242	66.1
	No	124	33.9
Having toilets that are in sex-separated rooms	Yes	286	78.1
	No	80	21.9
Having separated toilets with menstrual hygiene needs (covered bin, and/or water and soap) for female	Yes	219	59.8
	No	147	40.2
Having an accessible toilet for people with limited mobility*	Yes	232	63.4
	No	134	36.6
Having clean toilet	Yes	339	92.6
	No	27	7.4
Having functional lighting in all latrines	Yes	340	92.9
	No	26	7.1
Having sufficient number of toilets (one per 20 users for inpatient settings	Yes	144	39.3
	No	222	60.7
Having at least four toilets per outpatient setting	Yes	109	29.8
	No	257	70.2

*Toilet designed for limited mobility with ramp and handrail

Table 4 Coverage JMP sanitation service level among healthcare facilities in addis Ababa, Ethiopia (*n*=366)

Study variables	Frequency	Percent
Sanitation services		
Advanced sanitation service	53	14.5
Basic sanitation service	85	23.2
Limited sanitation service	288	62.3
No sanitation service	0	0

Sanitation service levels among HCFs

In this study, 62.3%, 23.2% and 14.5% of healthcare facilities had limited, basic and advanced sanitation services, respectively (Table 4).

Factors influencing access to advanced sanitation service level

In the binary logistic regression analysis, thirteen (13) independent variables included: healthcare facilities having an effective WASH-FIT committee/infection prevention committee(IPC**)**, healthcare facilities having trained managers on sanitation safety plans, healthcare facilities having a focal person for sanitation services, healthcare facilities having trained managers on infection prevention, healthcare facilities having sanitation standards, healthcare facilities having sufficient budget allocations for sanitation services, healthcare facilities having a specific annual plan for sanitation services, healthcare facilities having updated WASH guidelines, healthcare facilities having managers organizing training at least biannually on WASH services, healthcare facilities having a sanitation safety plan, healthcare facilities having regular monitoring and evaluation practices by managers, healthcare facilities having managers participating actively in the renovation of WASH infrastructure, and healthcare facilities having an environmental health club or committee were significantly associated (p-value < 0.05) at a 95% confidence interval with access to advanced sanitation services. Similarly, in the multivariable logistic regression analysis, all variables except for healthcare facilities having a focal person for sanitation services and those having an environmental health club or committee were significantly associated (p-value < 0.05 at 95% CI) with having an advanced sanitation service level (Table 5).

Bacteriological and physico-chemical quality of water supply in HCFs

In this investigation, 22.7% of samples tested positive for *enterococci*, 26% *for Escherichia coli*, 35% for *fecal coliforms*, and 38.8% for *total coliforms*. Regarding chemical parameters, all samples (100%) met the fluoride and conductivity standards, with fluoride levels at ≤1.5 mg/l and conductivity at ≤1500 µS/cm. The pH levels showed that 93.4% of samples were between 6 and 8.5, while 6.6% exceeded the permissible level of 8.5. All samples (100%) complied with the allowable limit (below 1000 mg/l) for total dissolved solids (TDS) (Table 6).

Bacteriological and physico-chemical water quality of reservoirs and distributaries (WRD)

In terms of bacteriological parameters, all (100%) water samples taken from the reservoirs and distributors tested negative for *Enterococci*, *Escherichia coli*, *fecal coliforms*, and *total coliforms*. For the physico-chemical parameters, fluoride levels were ≤1.5 mg/l in all 5 samples (100%), and

Table 5 Multivariable logistic regression analysis with selected predictors of advanced sanitation service level (*n*=366)

Study variables	Category	Advanced sanitation service		P value	AOR [95%CI]
		Yes	No		
Healthcare facilities having effective WASH-FIT committee/infection prevention committee (IPC)	Yes	40	95	0.036	2.8(1.07-7.520
	No	13	218		References
Managers receiving training about sanitation safety plan	Yes	39	79	0.032	2.96(1.10-7.94)
	No	14	234		Reference
Managers receiving training about infection prevention	Yes	38	76	0.018	3.6(1.25-10.48)
	No	15	237		Reference
Healthcare facilities having sanitation standard or guideline	Yes	41	113	0.04	3.5(1.06-11.64)
	No	12	200		Reference
Healthcare facilities that have a sufficient budget with a specific budget line for sanitation services	Yes	44	128	0.027	3.2(1.14-9.15)
	No	9	185		Reference
A healthcare facility having a specific annual plan for sanitation services	Yes	33	89	0.004	3.6(1.52-8.58)
	No	20	224		Reference
Healthcare facilities have updated the WASH guidelines	Yes	42	119	0.041	3.4(1.05-11.20)
	No	11	194		References
Healthcare facilities have managers organizing training at least biannually on WASH services	Yes	38	85	0.007	3.7(1.42-9.40)
	No	15	228		References
A healthcare facility has sanitation safety plan	No	35	144	0.036	0.22(0.05-0.91)
	Yes	18	169		References
Healthcare facilities managers have practice of regular monitoring and evaluation of WASH services	No	36	165	0.024	0.24(0.07-0.83)
	Yes	17	148		Reference
Healthcare facilities managers having active participation during renovation of WASH infrastructure	No	39	170	0.15	0.56(0.35-0.70)
	Yes	14	143		Reference

Table 6 Bacteriological and physico-chemical drinking water quality of healthcare facilities in addis Ababa (*n*=366)

Study variables	Category	Frequency	Percentage
Bacteriological parameters	**CFU/100ml**		
Enterococci	Negative	283	77.3
	Positive	83	22.7
Escherichia coli	Negative	271	74.0
	Positive	95	26.0
Fecal coliforms	Negative	238	65.0
	Positive	128	35.0
Total coliforms	Negative	224	61.2
	Positive	142	38.8
Physico-chemical parameters			
Fluoride	≤1.5 mg/l	366	100
Conductivity	≤1500 µS/cm	366	100
PH	6-8.5	342	93.4
	>8.5	24	6.6
Total dissolved solid(TDS)	<1000 mg/l	366	100

conductivity was ≤1500 µS/cm in all samples. The pH levels were measured; with 4 samples (80%) falling within the range of 6-8.5, and 1 sample (20%) exceeding 8.5. Total dissolved solids (TDS) were <1000 mg/l in all 5 samples (100%) (Tables 7 and 8).

In the qualitative study, there were a total of eight key informants, consisting of four female and four male managers or heads of infection prevention. In line with these universal principles, a qualitative study was conducted to assess the perceptions of healthcare managers/infection prevention heads on WASH services in Addis Ababa healthcare facilities. Accordingly, the study explored that access to basic WASH services remains a significant issue especially in primary healthcare facilities, with many facilities lacking essential services, almost majority of participants reported that, they do not have clean water to maintain hand hygiene or sanitation services. The majority of the informants noted that healthcare facilities are facing difficulties in access to clean water. As noted, majority of healthcare facilities access water from municipality pipeline only once a week, sometimes even it goes beyond a week. It's also understood that; majority of health facilities are struggling to solve water shortage through storage in tankers and purchase from the outside with high price. In exploring the issue, participants noted,

In our health facility, the WASH services are very low. The reason is that we don't have our own water ground sources; we use the government pipeline which has water only once a week, even it goes soon without filling our tankers. Thus, majority of our water need is covered by purchase and exposed us to poor water quality (IDIs 01, IPC focal).

The problem of water service in our city is obvious, we get once a week. We have six tankers which are connected by automatic pump; we fill all and use it for a week. But there is a time when we get water once in two week or three weeks (IDIs 06, IPC focal).

Water comes once a week. We store in a tanker; we have storage tanker. But there is a time when get a water beyond

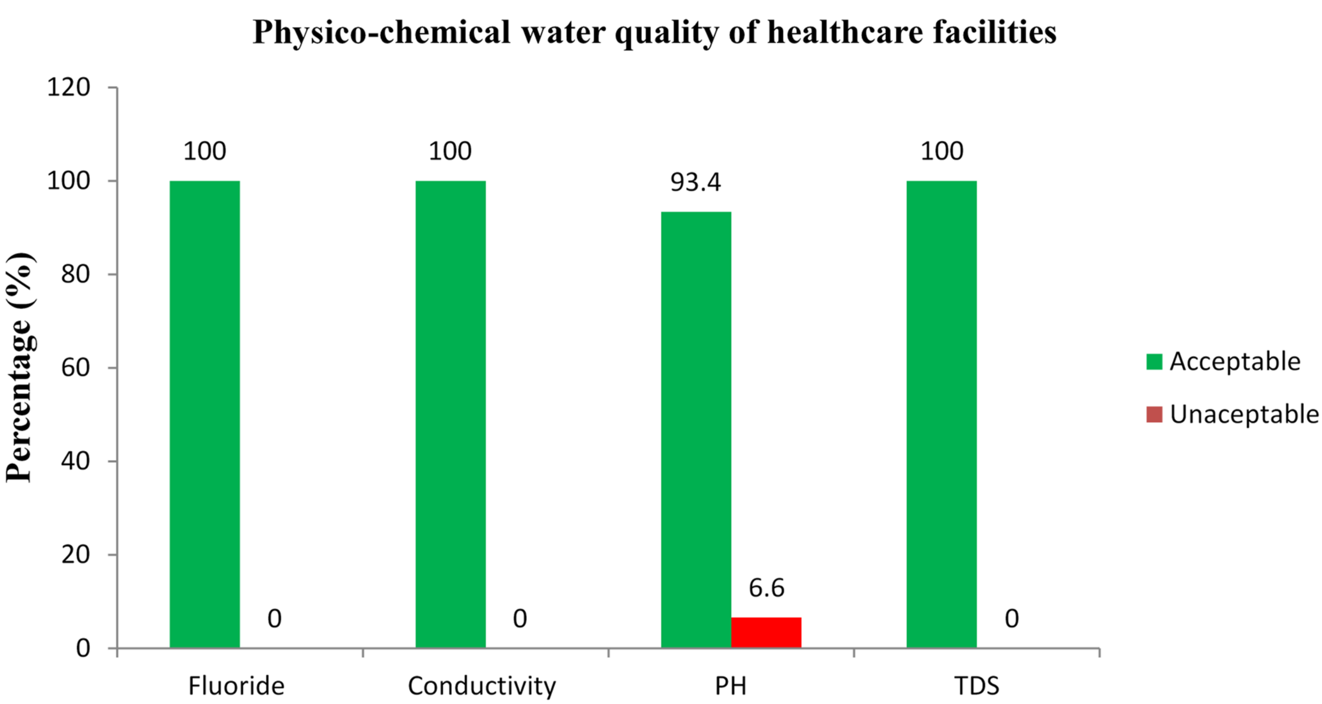

Fig. 2 Bacteriological drinking water quality of Healthcare facilities of Addis Ababa

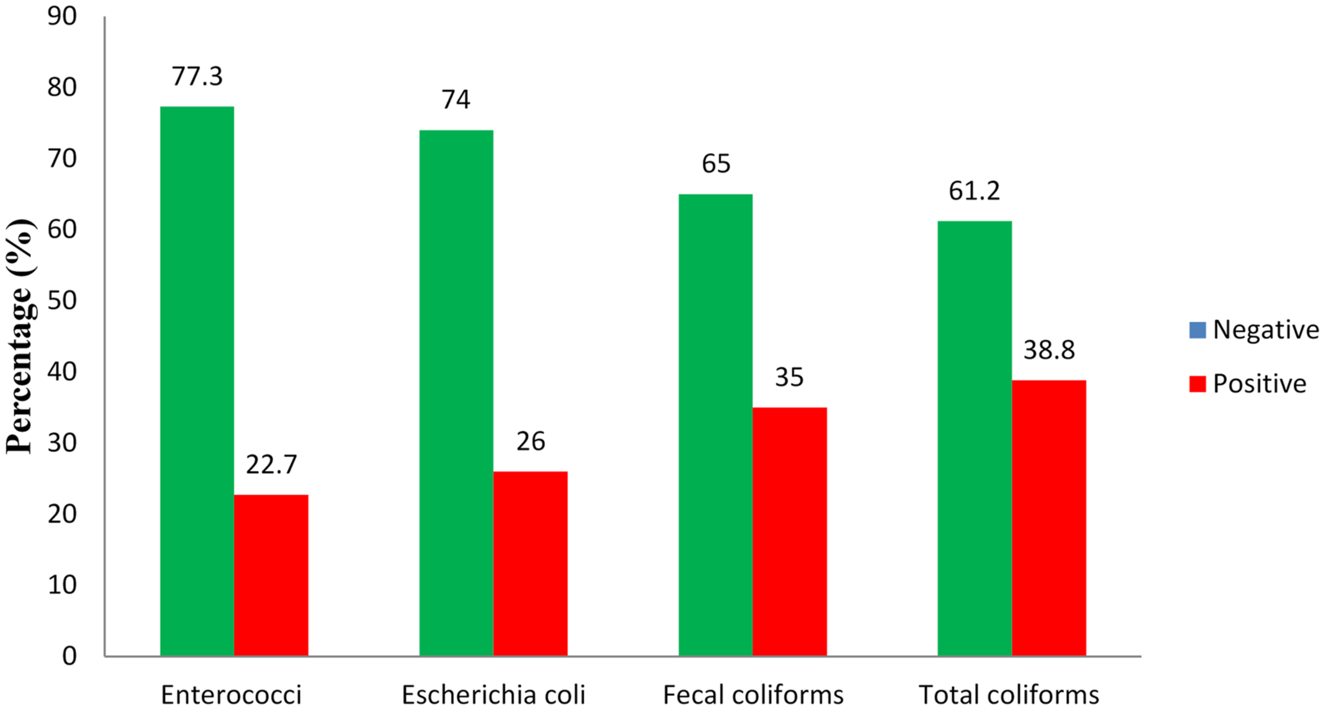

Fig. 3 Physico-chemical water quality of healthcare facilities of Addis Ababa

Table 7 Bacteriological and physico-chemical drinking water quality of the addis Ababa City administration water reservoirs and distribution (n=5)

Study variables	Category	Frequency	Percentage
Bacteriological parameters	**CFU/100ml**		
Enterococci	Negative	5	100
Escherichia coli	Negative	5	100
Fecal coliforms	Negative	5	100
Total coliforms	Negative	5	100
Phisico-chemical parameters			
Fluoride	≤1.5 mg/l	5	100
Conductivity	≤1500 µS/cm	5	100
PH	6-8.5	4	80
	>8.5	1	20
Total dissolved solid(TDS)	<1000 mg/l	5	100

Table 8 Facility type and key informant participants detail

No	Codes	Healthcare facility type	Position of interviewee	New code
1	160102_0553	Medium clinic	Infection prevention head	IDI, 01
2	160102_0624	Internal medicine specialty center	Infection prevention head	IDI, 02
3	160103_0039	Dental clinic	Manager	IDI, 03
4	160103_0102	Internal medicine specialty clinic	Infection prevention head	IDI, 04
5	160103_0423	Medium clinic	Infection prevention head	IDI, 05
6	160103_0514	Medium clinic	Infection prevention head	IDI, 06
7	160105_2219	Health center	Infection prevention head	IDI, 09
8	160105_2303	Hospital	Infection prevention head	IDI, 08

a week. In such situation we buy it in tanker from outside (IDIs 07, IPC focal).

Though some participants noted that an attempt has been made to solve the problem of water shortage through buying in tankers form external distributors, the high price and water quality issue might affect them.

The quality water accessibility is not good, we have many tankers, and we store in there and use it. But sometimes we face shortages, become contaminated, and we purchase it with high cost and re-fill the tankers … (IDIs 04, IPC focal).

Our water source is the municipality pipeline, not unique or special pipeline. Most of the time we use purchased water by tanker, which is expensive; even we don't get it timely. This all have effect on WASH services (IDIs 01, IPC focal).

… we purchase water most of the time, one tanker costs up-to 3000ETB. We purchase four to five tankers in a week, it's easy to calculate how it's costing us (IDIs 03, manager).

Despite varying perspectives on availability of WASH services in health facilities, some participants noted to have better access to water services. Participants of the study

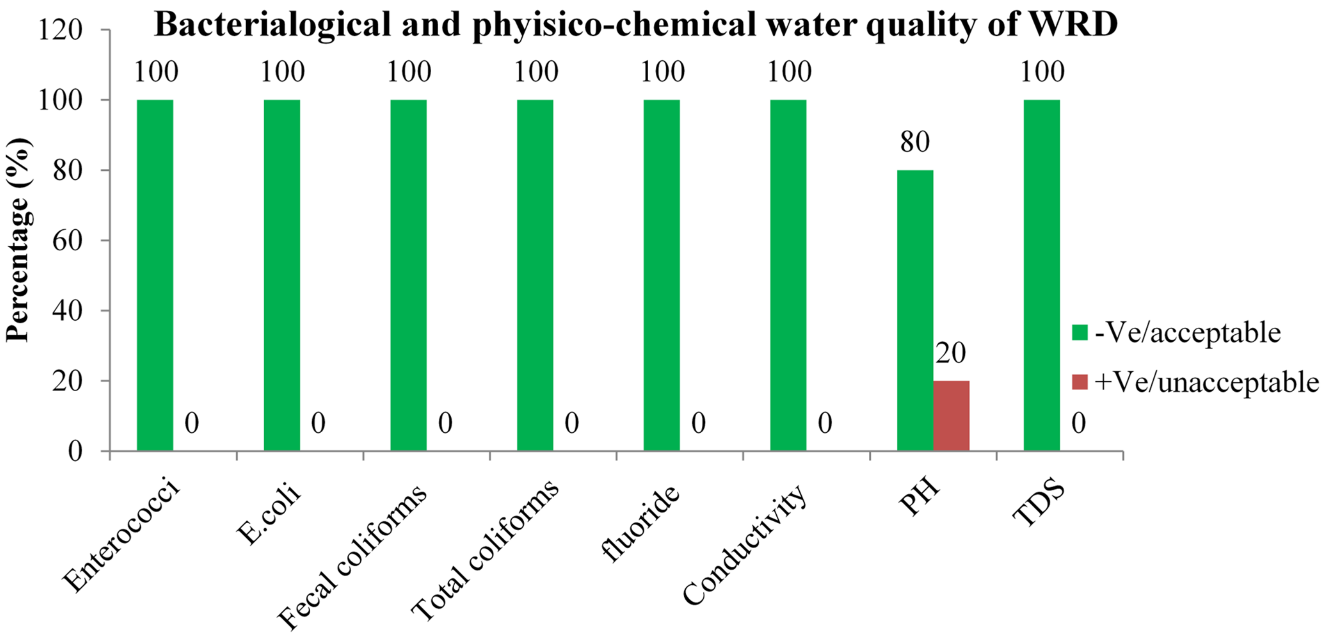

Fig. 4 Bacteriological and physico-chemical water quality of the Addis Ababa water reservoirs and distributes (WRD

noted to have better access of water since their facility is connected to unique pipeline and stressed the importance of water to provide critical health services, such as OR and maternal delivery services.

This is a health facility, there is OR services, there are maternal delivery services, so water service is highly demanded. We get water three times a week, so we do have better access to water. I think the good thing is the pipeline is connected to the factory line, not the community pipeline, that's why we get better water access (IDIs 05, IPC focal).

We have good WASH services in our facility, we have many tankers which stores about 28,000 L, and placed in different service delivery points. Though water cut is a normal phenomenon in our city, we don't face such a shortage (IDIs 02, IPC focal).

Another participant explained the accessibilities of WASH services in terms of availabilities of infrastructures. And noted that, the facility has its own ground water source and other important infrastructures for improving sanitation services.

Concerning WASH, on each ward there are showers, toilets and hand washes, there are also water reservoir. In addition, we have the public pipeline and ground water source, so water is accessible (IDIs 08, IPC focal).

Why healthcare facilities lack sanitation services: key factors

Lack of ground water source in health facilities

Groundwater is crucial for health facilities as it provides a reliable source of water for essential activities like drinking, sanitation, and hygiene, which are vital for preventing the spread of waterborne diseases. In addition, groundwater can also contribute to the health of patients by providing the water needed for cooking, washing, and hygiene practices. Though the importance of ground water in health facilities is well articulated, participants of the study noted that, majority of health facility lacks to have ground water sources.

The main problem is that we don't have our own water sources, we can solve our problem if we have a ground water source. Secondly, our water source is the municipality pipeline, not unique or special pipeline (IDIs 01, IPC focal).

Lack of WASH infrastructure in health facilities

WASH infrastructure in health facilities denotes the provision of water, sanitation, hygiene, and healthcare waste management services, as well as environmental cleaning, within healthcare facilities. They are crucial for preventing infections, protecting staff and patients, and ensuring dignified care for vulnerable populations. However, the transcripts of this study depict that, health facilities lack WASH infrastructures, among all, lack of water tanker, toilet and office facilities are noted to be challenging.

Fortunately, this facility is old, but new facilities may not have enough tankers for water storage or may not have financial capacity to cover their water bill or water bill may not be paid on time due to several factors… (IDIs 06, IPC focal).

Concerning sanitation, we have toilets though they are not enough. Since we have space problem, we do have infrastructure problem. The rooms are very small, ignore the sanitation they are not conducive to give heath service. Some rooms are providing double services. We don't have hand washing place in OPDs (IDIs 07, IPC focal).

Another participant explained factors affecting WASH services in terms of mal-functioning, especially broken drainage system and presence of prolonged procurement process. The failure of a drainage system can lead to flooding and contamination, which can adversely affect community health, making prompt intervention essential.

… the other thing is mal-function of WASH facilities and broken drainage system, since they are maintained through government procurement process, it may take long time to fix (IDIs 08, IPC focal).

… sometimes construction of roads might damage the water pipeline … (IDIs 05, IPC focal).

Water interruption and cuts in a healthcare facility

Whether due to a temporary or a sustained shortage, water cut in a health facility poses significant challenges to patient care and staff safety. It can lead to serious disruptions in essential services, increasing the risk of infections and impacting patient care. This study explored that, water cut was one of the main factors affecting health facilities in several ways, due to the fact that water matters in health facilities.

The main thing is water cut from the municipality, health facility should be seen differently and priority should be given to them, because it's difficult to provide health services without water… (IDIs 08, IPC focal).

Firstly, I would say its water availability. As you know there is water shortage in our city, if you go to the government health facility, water availability is on and off, sanitation and hygiene is highly linked with water (IDIs 02, IPC focal).

Another participant noted the problem of water cut in health facility and further explained the concerns over the power of water, quality of water and finally concludes his idea by arguing that, there might be other factors that affects WASH services in health facilities.

The main is challenge is water cut, water is on and off in the city. In addition, the water has no power and sometimes its dirty. But generally speaking, what I know is, we do have shortages of water, but I don't know the actual factors that caused it (IDIs 04, IPC focal).

Increasing demand of water

The demand for water is increasing across the globe due to factors like population growth, urbanization, economic development, and changing consumption patterns. This increasing demand is putting a strain on water resources and raising concerns about water scarcity. However, this study participants voiced their concerns on how population growth of the city across time significantly impacted water resources by increasing demand and potentially leading to scarcity.

Now may be the city is huge, the number of the population is also increasing from time to time, so water demand is high. These are all from my point of view (IDIs 05, IPC focal).

Efforts to improve WASH services in healthcare facilities: leadership commitment and policy framework

Leadership commitment

Leadership plays a crucial role in improving WASH services by prioritizing and driving inclusion, building political will, and fostering collaboration. Multi-sectoral collaboration plays a crucial role in improving WASH services by encouraging a more integrated and effective approach to addressing the complex challenges related to access, sustainability, and community needs. This collaboration brings together diverse stakeholders, including government agencies, NGOs, the private sector, and community members, to leverage their expertise, resources, and networks to achieve better outcomes. In relation to this, this study explored that, the health leaderships were leveraging their efforts to improve WASH services through internal coordination with the healthcare workers and multi-sectoral collaboration with others sectors. It's hoped that this approach will have an impact on improving WASH services in the health facilities.

Leaderships are doing good; they are cooperative to solve the water problems. They discuss the issue with the government water development bureau; however, the problem is not solved yet (IDIs 01, IPC focal).

As leaders, we oversee all departments. We do have also good cooperation with the sub-city sectors, they will visit and inspect us, they discuss with us about the WASH services (IDIs 02, IPC focal).

In addition, health leaderships were praised for their efforts for planning weekly and monthly sanitation campaigns, which are crucial for improving hygiene and sanitation practices, ultimately leading to a healthier and more sustainable environment. This approach provides regular opportunities for community engagement, education, and behavior change, fostering long-term positive impacts on public health and well-being. In explaining the issue, participants noted;

Starting from the top leadership we work together. We participate on weekly and monthly cleaning campaign. On the campaigns we invite the woreda cleaning administration, we also invite safety net workers. We also invite the community (IDIs 05, IPC focal).

We do cleaning campaign monthly in collaboration with woreda cleaning committee (IDIs 07, IPC focal).

This study explored the efforts of health leadership in terms of improving sanitation facilities. It's understood that, leadership plays a crucial role in the renovation of toilet facilities to fit for disabled individuals, ensuring accessibility and dignity. Leaders must advocate for inclusive design, prioritize user needs, and provide resources for implementing necessary changes. This study has explored the issue in that,

As much as possible, the leadership in collaboration with the workers are trying our best to improve WASH services in the facility. The leadership is good, previously the toilet is not convenient for disable people, but now the toilet is renovated and comfortable for disabled (IDIs 07, IPC focal).

Health policy framework and guidelines

A robust health policy framework and guidelines are crucial for improving WASH services, particularly in healthcare facilities. They provide a standardized approach, ensuring quality and safety for staff, patients, and visitors, and ultimately contribute to better health outcomes. The current study explored that, health facilities are determined to follow health policy and IPC procedures to improve WASH services. As noted,

Its mandatory to follow the infection prevention procedures despite it is not updated. Failure to follow that procedure is not allowed. So as a health facility we do our best to follow the existing IPC procedures. But there are many challenges to follow the procedures and standards (IDIs 01, IPC focal).

WASH is included in our IPC parts; it was given a great attention; thus, it aligns both with the hospitals strategy and policy (IDIs 08, IPC focal).

Discussion

This study assessed factors affecting access to advanced sanitation services and drinking-water quality in healthcare facilities in Addis Ababa, Ethiopia. Access to advanced sanitation services and clean water in healthcare facilities ensures patient safety and prevents healthcare-associated infections. This study reveals significant deficiencies in sanitation and access to clean water services in healthcare facilities in Addis Ababa, Ethiopia, highlighting the urgent need for comprehensive improvements. A key strategy for reducing infectious diseases is ensuring access to advanced sanitation and clean water services. The World Health Organization has highlighted the need for advanced sanitation services and adequate clean water in healthcare facilities to stop the spread of infectious diseases (World Health Organization 2018). The key principles of the Sustainable Development Goals (SDGs)—access to sanitation and clean water services- are crucial in improving the health of vulnerable populations, particularly mothers, children, newborns, patients, and healthcare providers (ESCAP 2018). However, this investigation revealed that a significant percentage of healthcare facilities lacked advanced sanitation services and clean water. While basic water and sanitation services are prioritized, advanced levels are crucial for optimal care. In this research, 14.5% and 23.2% of healthcare facilities had advanced and basic sanitation services. These results were higher compared to a study conducted on healthcare facilities in Bishoftu, Ethiopia, where access to advanced and basic sanitation services was nonexistent (Girmay et al. 2023). The recent findings reveal that a significant percentage of healthcare facilities are behind schedule in achieving Sustainable Development Goal (SDG) 6, which calls for universal access to basic sanitation services (>99%) by 2030. Furthermore, this study found that a substantial number (62.3%) of the healthcare facilities used limited sanitation services. This percentage is lower compared to a study conducted in 2022 in 86 healthcare facilities in Addis Ababa, where 100% of healthcare facilities had limited access to sanitation services (Derso et al. 2023). This could be due to differences in a representative sample. In addition, 22.7% of healthcare facility samples tested positive for *enterococci*, 26% for *Escherichia coli*, 35% for *fecal coliforms*, and 38.8% for *total coliforms*. These could be significant risk factors for spreading several infectious diseases resulting from poor water and sanitation services (Pal et al. 2018). Unsafe water and inadequate sanitation systems lead to social, economic, and political instability, threatening children and communities' survival, health, and development (Andrés et al. 2021; Zapasa et al. 2022). In this investigation, 100% of reservoirs and distributed water samples tested negative for *Enterococci*, *Escherichia coli*, *fecal coliforms*, and *total coliforms*. This indicates that the water contamination problem lies within the healthcare facilities, likely due to poor water management practices. Targeted interventions at healthcare facilities to improve water quality will be essential for reducing infections. Besides, the current study found that 66.1% of healthcare facilities had functional toilets dedicated to staff use, and merely 39.3% met the recommended standard of having one toilet for every 20 users in inpatient settings. This lack of adequate sanitation can severely compromise sanitation practices, leading to an increased risk of infections among patients and healthcare workers. Inadequate access to sanitation services directly correlates with higher rates of healthcare-associated infections (Watson et al. 2019). The World Health Organization emphasizes that safe sanitation is crucial for infection control, particularly in facilities catering to vulnerable populations (World Health Organization 2020b). The alarming statistics from this study underscore the need for urgent intervention to improve sanitation infrastructure and hygiene practices within these facilities. The recent study identified several key factors affecting access to advanced sanitation services in healthcare facilities. Accordingly, health facilities with effective WASH-FIT committee/infection prevention committee (IPC**)** had 2.8 times higher access to advanced sanitation service (AOR = 2.8, 95% CI: 1.07-7.52, p = 0.036) compared to those without such clubs. This suggests that fostering community engagement and ownership of sanitation initiatives can lead to significant improvements. Furthermore, healthcare facilities with managers trained in sanitation safety plans had 2.96 times higher access to advanced sanitation service (AOR = 2.96, 95% CI: 1.10-7.94, p = 0.032) than those without trained managers. Similarly, healthcare facilities with managers trained in infection prevention had 3.6 times higher odds of having advanced sanitation service (AOR = 3.6, 95% CI: 1.25-10.48, p = 0.018) compared to those who had not. This indicates that investing in training and capacity building for healthcare staff is crucial for fostering a culture of hygiene and sanitation. Additionally, healthcare facilities that had sanitation standards in place were 3.5 times more likely to have advanced sanitation service (AOR = 3.5, 95% CI: 1.06-11.64, p = 0.04) than those without such standards. Moreover, healthcare facilities with a sufficient budget specifically allocated for sanitation services had 3.2 times higher access to advanced sanitation service (AOR = 3.2, 95% CI: 1.14-9.15, p = 0.027) than those without. Over 52.2% of healthcare facilities reported lacking sufficient funding for sanitation initiatives. This financial shortfall limits the ability of facilities to maintain, upgrade, or expand their sanitation infrastructure, ultimately compromising the quality of care provided. Facilities with a specific annual plan for sanitation services were 3.6 times more likely to have advanced sanitation service (AOR = 3.6, 95% CI: 1.52-8.58, p = 0.004) than those without such a plan. Additionally, healthcare facilities with updated WASH guidelines were 3.4 times more likely to have advanced sanitation service (AOR = 3.4, 95% CI: 1.05-11.20, p = 0.041) compared to those without. On the other hand, healthcare facilities without a sanitation safety plan were 22% less likely to have advanced sanitation service (AOR = 0.22, 95% CI: 0.05-0.91, p = 0.036) than those with a sanitation safety plan. The absence of a sanitation safety plan in many facilities reflects a lack of strategic planning and prioritization of sanitation services. Similarly, facilities whose managers did not engage in regular monitoring and evaluation of WASH services were 24% less likely to have advanced sanitation service (AOR = 0.24, 95% CI: 0.07-0.83, p = 0.024) compared to those that practiced such monitoring. Furthermore, healthcare facilities whose managers were not actively involved in leading renovation of WASH infrastructure had 56% lower odds of having advanced sanitation service (AOR = 0.56, 95% CI: 0.35-0.70, p = 0.15) than those that actively participated (Table 5).

The findings of this study reflect broader systemic challenges within the healthcare facilities framework. The reliance on municipal water sources, which are often inconsistent and unreliable, emphasizes the need for sustainable water management strategies. Many facilities reported receiving water only once a week, leading to reliance on expensive tanker water, which can pose additional risks to water quality.

Strengths and limitations

The study has several strengths. Firstly, it employs a comprehensive data collection approach through a convergent sequential design, integrating both qualitative and quantitative methods. This multifaceted approach enables a holistic understanding of the factors influencing sanitation and water quality in healthcare facilities. Additionally, the study involves a substantial sample size of 382 healthcare facilities, enhancing the generalizability of the findings across the healthcare landscape in Addis Ababa, Ethiopia. Moreover, the diverse data sources utilized—including observations, interviews, and laboratory tests—provide a rich perspective on the issues at hand. Furthermore, the laboratory-based analysis of water samples allows for precise measurements of bacteriological and physicochemical parameters, significantly strengthening the credibility of the findings. Despite its strengths, the study also has notable limitations. One primary concern is its cross-sectional design, which restricts the ability to establish causal relationships between the identified factors and access to advanced sanitation services. Additionally, the reliance on interviews with facility managers for data collection may introduce bias, as responses could be influenced by social desirability or a lack of awareness regarding the actual conditions in their facilities. Furthermore, the geographic scope of the study is limited to Addis Ababa and may not fully represent healthcare facilities in other regions of Ethiopia.

Conclusion

Access to advanced and basic sanitation services is low. Several core factors affecting access to advanced sanitation service level has been identified. Many water samples from healthcare facilities were contaminated with Enterococci, Escherichia coli, fecal coliforms, and total coliforms. Addressing the gaps in access to sanitation services and clean water in healthcare facilities in Addis Ababa requires a multifaceted approach. Enhancing training programs for healthcare managers and securing adequate findings are critical steps toward improving sanitation and water quality. By prioritizing these areas, healthcare facilities can significantly reduce the incidence of infections, enhance patient safety, and improve the overall quality of care provided. This study serves as a call to action for healthcare managers to recognize and address the urgent need for improved sanitation services as part of a broader strategy to strengthen healthcare infrastructure in Ethiopia.

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Author contributions MTR was responsible for conceptualization, data curation, coordination, methodology, formal analysis, and drafting the original manuscript. AA, SRG, and BMA contributed to the methodology. All authors contributed to investigation, visualization, reviewing, editing, and approving the final manuscript.

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Data availability All authors reviewed and approved the final version of the manuscript. Additionally, we confirm that the dataset supporting the findings of this study is available within the article and/or its supplementary materials.

Declarations

Consent for publication No consent to publish was necessary for this study, as we did not include any details, videos, or images related to individual participants.

Conflict of interest The authors declare no competing of interests.

Ethical approval and consent to participate Ethical approval was granted by Addis Ababa University (reference number EIWR/IRC/00315/2024) and the Institutional Review Board (IRB) of the Addis Ababa Health Bureau (reference number A/A/11/16212/227). Prior to data collection, written consent was secured from each participant. They were informed that participation was voluntary, and measures were taken to ensure the confidentiality of their information and privacy throughout the research process. Participants were also made aware that they could refuse or withdraw from the study at any time. The research methods strictly adhered to the principles outlined in the 1964 Helsinki Declaration and its subsequent amendments, as well as other relevant ethical standards.

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