

Household Water Treatment and Storage Practices Among Residents in Mogadishu Somalia

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Abstract: Background: Consumption of contaminated water can affect human health and even lead to high morbidity and mortality, particularly among under-five children. Thus, determining household water treatment and proper management is vital to eliminate contamination. This study aimed to assess the household water treatment and storage practices among Warta-Nabada residents in Mogadishu, Somalia. Methods: A community-based cross-sectional study was conducted in 386 households from the April to June 2018 period. A multistage cluster sampling technique was used to select sample units from the households to obtain accurate data. Data were collected using structured questionnaires. Also, SPSS version 21 was used for data entry and analysis, respectively. The univariate, bivariate, and multivariate levels were analyzed to see a significant association between variables. The statistical significance was declared at a value < 0.05 with 95% confidence intervals in the final model. Results: The majority of participants, 291 (75.4%), used plastic containers for water storage at a household level, while 48 (12.4%) used clay pots, followed by 47 (12.2%) cement tanks. Most containers used for water storage were plastic containers due to their availability and low cost. Participants who had containers were 227 (58.8%). Approximately 114 (29.5%) had two containers. The number of people who practice boiling water was relatively low (15.8%). The distance of the water source from household 143 (37.0%) were more than 50 meters, regards to methods for water treatment, 91 (23.6%) were used for chlorination, and 61 (15.8%) were used for boiling, but 45 (11.7%) were used for filtration, and 22 (5.7%) used solar disinfection as well. Therefore, the most common water treatment method used was chlorination, accounting for (23.6%) of the total water treated. Conclusion: According to the results, it can be concluded there were significant variables for age, marital status, occupational, and education of the husband of the household water treatment level. When there was a high risk of acute water diarrhea or cholera, drinking water chlorination, boiling, and filtration were the most common household water treatment practices. Among a group of good practices, there were (73%) while the poor practices group had (27%). However, the majority of residents practice precisely. This study recommended developing a comprehensive national plan for scaling up the household water treatment system with a holistic approach, allowing adequate service provision and addressing the need to provide for the most vulnerable groups with better practices.

Keywords: Household Water Treatment, Residents, Knowledge Level, Practices, Water Storage

1. Introduction

Today, millions of people worldwide do not have access to safe water, particularly among the population of developing and underdeveloped countries [1]. A study conducted by

WHO and UNICEF highlighted that more than 700 million people in the world do not access improved drinking water sources, due to the nature of their construction, are protected from outside contamination. Drinking water quality has shown that hundreds of millions of people with "improved"

drinking water do not have access to a source that is microbiologically safe to drink [2]. Globally, household water treatment is not feasible at the household level, indicating that they are left with the responsibility of needing to collect, treat, and store their water for safety and improved health [3]. Although many countries' groundwater is inaccessible or contaminated, these users depend on household water treatment systems for safe drinking water storage because 663 million people lack improved drinking water sources [4]. Therefore, contaminated water resulting from unsafe consumer storage and poor handling practices at the household level causes diarrhea [5].

Approximately half of the people using unimproved drinking water sources live in Sub-Saharan Africa, while one-fifth live in Southern Asia. Furthermore, Sub-Saharan Africa has made little progress, with 43% of its population having access to improved drinking water, while some developing countries in other regions are said to be falling behind the MDGs standards for drinking water that needs further consideration [6]. These household water treatment systems aim to provide safe drinking water affordably and sustainably [7]. However, the inhabitants can manage their use of water and easy to avoid water-borne diseases [8].

The regular practice of household-level water treatment is crucial in reducing the occurrence of diarrheal and other devastating illnesses [9]. Currently, 84 2000 people and 36 1000 children aged less than five years are estimated to die from diarrhea due to unsafe drinking water, poor sanitation, and hand hygiene practices. Although communities may have access to piped water at home, it may be contaminated by defects in the distribution system or improper storage [10]. A recent study in Somalia highlighted that (66.1%) are not treating their water instead of (31.5%) practicing any water treatment method. Water chlorination was used as a disinfectant by more than (27.3%). Around (4.0%) used boiling as a means of water treatment as well. Among those, (38.8%) believed that water is safe naturally. Most of the households (97.6%) had drinking water containers. Approximately (80.6%) of families indicated that they use Jerri cans for water collection and storage, and only (3.6%) have a bucket without a lid for water storage [11]. There is a commitment to safe household water treatment and storage, which has led to the formation of the WHO-sponsored international network promotion that has brought together several stakeholders to improve household water management as a component of water, sanitation, and hygiene programs [12]. This study aimed to assess household water and storage practices in Warta-Nabada district, Mogadishu, Somalia.

2. Methods and Materials

2.1. Study Design, and Site

Community-based cross-sectional study was conducted during the period between April to June 2018 in Warta-Nabada, Mogadishu, Somalia.

2.2. Sample Size Calculation

The sample size was calculated using Slovene's formula, which is $n = N / (1 + (N * e^2))$, where n = sample size and N = population and e = 5% margin of error $N = 10,600 / (1 + 1/10,600 * 0.0025) = 386$ households.

2.3. Sampling Technique

A multistage cluster sampling technique was used to select sample units from the sampled households: In the first stage, the sampling frame consists of five sections. In the second stage of each selected section, respondents were selected based on sub-sections. The third stage, from each selected sub-section, was divided into blocks. From each block, the study participants have been selected randomly through systematic sampling.

2.4. Data Collection Techniques and Instruments

This quantitative study used a structured questionnaire for interviews. Both closed-ended and open-ended questions were utilized for data collection. During the data, collection interviews were conducted in the local language and then professionally translated to English. Three qualified experts validated the translation process to ensure validity, and they prepared the manuscript in English.

2.5. Data Analysis

The Statistical Package for Social Sciences (SPSS) software, 21 versions, was used to code, enter, and analyze data. The univariate analysis was used to provide frequency, percentages and draw various charts. The logistic regression analysis and odds ratios were also used to determine the relationships between variables. The level of significance was set at $P < 0.05$ and 95% confidence intervals.

2.6. Ethical Considerations

Ethical approval for the study was obtained from the Benadir University, Postgraduate Studies and Research Centre Ethics Committee. Every participant gave their informed consent before participating in the study. Participants' information and identifiers were appropriately reserved.

3. Results

3.1. Socio-demographic Characteristics

Table 1 shows the age distribution of the respondents was 258 (66.8%) and ranged from 16-39 years, among 128 (33.2%) were 40-86 years, respectively. The majority were aged between 16 and 39 years, which is about 258 (66.8%), mainly related to those interested in a household water treatment. These findings also revealed that 166 (43.3%) participants were males, while 220 (57.0%) were female. Over, 221 (57.3%) of the respondents were married, followed by 98 (25.4%) of the single participants, and 36 (9.3%) were divorced. Only 31 (8.0%) were widowed. Among 151,

(39.1%) could not read, but 86 (22.3%) could read and write. Only 69 (17.9%) were primary, 43 (11.1%) were secondary, and 37 (9.6%) were university level. Therefore, 121 (31.3%) were housewives, but 90 (23.3%) were government employees, and 88 (22.8%) were private employees, while 63 (16.3%) were laborers, and 20 (5.2%) were merchants. The educational status of a husband who cannot read and write was 60 (15.1%), and 58 (15.0%) could read and write, while 21 (5.4%) were primary, and 46 (11.9%) were secondary level, but 25 (6.5%) were above secondary, although 12 (3.1%) were Quranic level.

The educational status of the wives varied. Among 59 (15.3%) could read and write, but 50 (13.0%) could not read and write. Of those, 19 (4.9%) were primary level, but

31 (8.0%) were secondary, while 3 (0.8%) were above secondary. The occupational status of the husbands was 43 (11.1%). The proportion of daily laborers was 57 (14.8%), mainly working as private employees, but the merchant proportion was 54 (14.0%), and this is the 46 (11.9%) were government employees. Meanwhile, 16 (4.1%) were farmers, so most of the husbands were private employees. The family size was 135 (35.0%) 3-4, while 127 (32.9%) were 2-3 people, but 86 (22.3%) were 4-10 people. However, the largest family size was 135 (35.0%), between 3-4 people per household. Regarding monthly income, 138 (35.8%) were around 50-100 dollars, 175 (45.3%) were 100-200, and 73 (18.9%) were more than 200, while 86 (22.3%) were 4-10.

Table 1. Socio-demographic characteristics.

Variables	Frequencies (%)	Variables (%)	Frequencies (%)
Age		Education of husband	
16-39 years	258 (66.8)	Can't read and write	60 (15.1)
40-86 years	128 (33.2)	Can read and write	58 (15.0)
Sex of respondent		Primary (grade 1)	21 (5.4)
Male	166 (43.0)	Secondary (9-12)	46 (11.9)
Female	220 (57.0)	Education of wife	
Marital status		Can't read and write	50 (13.0)
Single	98 (25.4)	Can read and write	59 (15.3)
Married	221 (57.3)	Primary (grade 1)	19 (4.9)
Divorced	36 (9.3)	Secondary (9-12)	31 (8.0)
Widowed	31 (8.0)	Above secondary	3 (0.8)
Educational status		Occupation of husband	
Can't read and write	151 (39.1)	Farmer	43 (11.1)
Can read and write	86 (22.3)	Government employee	46 (11.9)
Primary (grade 1-8)	69 (17.9)	Private employee	57 (14.8)
Secondary (9-12)	43 (11.1)	Daily laborer	54 (14.0)
University	37 (9.6)	Merchant	16 (4.1)
Current occupation		Family size	
Housewife	121 (31.3)	2-3	127 (32.9)
Government employee	90 (23.3)	3-4	135 (35.0)
Private employee	88 (22.8)	4-10	86 (22.3)
Laborer	63 (16.3)	10>	38 (9.8)
Merchant	20 (5.2)	Monthly income	
Farmer	4 (1.0)	50 -100	138 (35.8)
		100- 200	175 (45.3)
		More than 200	73 (18.9)

Table 2. Water Accessibility and environmental characteristics.

Variable	Frequency (%)	Variable	Frequency (%)
Did you access water?		Did you met Challenges?	
Yes	386 (100.0)	No	214 (55.4)
Distance of water		Yes	172 (44.6)
between 30 and 50 m	133 (34.5)	Source water for general use	
More than 50 m	143 (37.0)	Water tap	220 (57.0)
Less than 30 m	110 (28.5)	Well	140 (36.3)
Piped water	26 (6.7)		
Source of drink water		Is this source protected?	
Water tap	149 (38.6)	Yes	299 (77.5)
Well	76 (19.7)	No	87 (22.5)
Piped water	158 (40.9)	Does the tap leak?	
Surface water	3 (0.8)	Yes	126 (32.6)
Days of water is off		No	260 (67.4)
One day per week	255 (66.1)		
Two days per week	113 (29.3)		
More than two days	18 (4.7)		

3.2. Water Accessibility and Environmental Characteristics

This study found that 386 (100%) of the respondents could access water. The distance of the water source from household 143 (37.0%) was more than 50 meters. In contrast, 30 and 50 meters were 133 (34.5%) of the water distance while 110 (28.5%) were less than 30 meters. The water tap is around 149 (38.6%). Even though 79 (19.7%) were obtained from the well, 158 (40.9%) were obtained from piped water, but 3 (0.8%) got surface water. Due to this reason, the most consumed water source is piped water at 158 (40.9%). Approximately one day per week, water is off for 255 (66.1%), and 113 (29.3%) two days per week, while 18 (4.7%) are off more than two days. Most of the time, water off is one day per week, 255 (66.1%). Regarding challenges of water accessibility, 214 (55.4%) were answered no, while 172 (44.6%) were answered yes. Around 220 (57.0%) got water from the water tap. The 140 (36.3%) get their water from a well, while 26 (6.7%) get it from a pipe, and 299 (77.5%) answered yes, while 87 (22.5%) answered no. We asked the participants if their tap was leaking; 260 (67.4%) answered no, and 126 (32.6%) answered yes, respectively.

3.3. Water Storage and Practice at the Household Level

In Table 3, most containers for water storage at the household level were plastic container 291 (75.4%). Approximately 48 (12.4%) were used clay pots, and 47 (12.2%) were cement tanks. Most containers used for water storage in households are plastic containers because of their availability and low cost in the market. Residents who have containers were 227, (58.8%). Among the 114 (29.5%) had two containers. Nearly 43 (11.1%) had three containers. Only two (0.5%) had more than three containers. In the Warta-Nabada district, residents had one container out of 227 (58.8%) with the proper capacity. For 144, (37.3%) were practiced ≤ 25 liters, and 242 (62.7%) were > 25 liters. Regarding the condition of containers, 280 (72.5%) were clean, while 106 (27.5%) were dirty. More than 230 (59.6%) covered their containers, and 156 (40.4%) answered no as well. Children use their cups for drinking water. The 163 (42.2%) and 138 (35.8%) were used with one single cup. The 59 (35.8%) were used with their hands, 26 (6.7%) were used with their mouth.

Table 3. Water storage and practice at household level.

Variable	Frequency (%)	Variable	Frequency (%)
Type of container		Container wash	
Plastic container	291 (75.4)	No	105 (27.2)
Clay pot	48 (12.4)	Yes	281 (72.8)
Cement tank	47 (12.2)	Cleaning water container	
Containers have		Daily	41 (10.6)
One	227 (58.8)	Several times per week	122 (31.6)
Two	114 (29.5)	One a week	91 (23.6)
Three	43 (11.1)	Once a month	19 (4.9)
More than three	2 (0.5)	Don't know	8 (2.1)
Capacity of container		Materials wash container	
≤ 25 Liters	144 (37.3)	Vegetation	26 (6.7)
> 25 Liters	242 (62.7)	Chemicals	83 (21.5)
Condition of containers		Only water	136 (35.2)
Clean	280 (72.5)	Water with soap	36 (9.3)
Dirty	106 (27.5)	Did you fetch the water?	
Did you cover container?		No	273 (70.7)
No	230 (59.6)	Yes	113 (29.3)
Yes	156 (40.4)	Container use for fetching	
Children drink		Clay pot	16 (4.1)
With their own cups	163 (42.2)	Jerri can	98 (25.4)
With one single cup	138 (35.8)	Did you wash your hands?	
With their hands	59 (35.8)	No	207 (53.6)
With their mouths	26 (6.7)	Yes	179 (46.4)
Days water is stored		Times fetch per day	
For two days	124 (32.1)	One	39 (10.1)
For three days	140 (36.3)	Two	48 (12.4)
More than three days	122 (31.6)	Three	23 (6.0)
		More than Four	4 (1.0)

Therefore, most children use it when they drink their cups, 163 (42.2%). The number of days for water stored in the household was two days, 124 (32.1%). Also, 140, (36.3%) were stored for three days in their water. For these results, 122 (31.6%) were stored for more than three days compared to the above results. The longest days were three days, 140 (36.3%). When asked if they washed their containers regularly, 281 (72.8%) said yes, and 105 (27.2%) said no. The study

participants cleaned their water containers daily to keep them safe. Households of 41 (10.6%) and 122 (31.6%) were cleaned multiple times per week, respectively. Materials used for container washing, 1136 (35.2%) were used only for water for cleaning, while 26 (6.7%) were used for vegetation. Less than 83 (21.5%) were used as chemicals, and 36 (9.3%) were used as soap with water. More than 273 (70.7%) answered no in the water fetching test, while 113 (29.3%) answered yes. The

respondents who use containers for fetching, 98 (25.4%) use Jerri cans, and 16 (4.1%) use clay pots. Twenty-four percent of the Jerri cans are the most usable water fetching in the study site. Furthermore, when it came to washing their hands, 207 (53.6%) did not wash their hands after dipping them in water, while 179 (46.4%) did so regularly. For instance, 39 (10.1%) were fetched one time, with 48 (12.4%) fetched two times, instead of 23 (6.0%) fetched three times, while 4 (1.0%) were fetched more than four times.

3.4. The Knowledge Level and Methods of Household Water Treatment

Table 4 shows the majority of the respondents have known the household water treatment and its practices properly 272 (70.5%), but 114 (29.5%) was not known how to practice household water treatment. Regarding the objectives of

household water treatment, 163 (42.2%) answered prevent diarrheal disease, while 76 (19.7%) answered reduces infant mortality. In addition, these respondents know how to reduce water-borne diseases 32 (8.3%). Moreover, 262 (67.9%) of the participants did not have knowledge of the causes of water contamination. The 124 (32.1%) of the participants know the underlying causes of water contamination, and 226 (58.5%) answered diarrheal disease, while 105 (27.2%) answered infant mortality, 36 (9.3%) answered malnutrition, and 19 (4.9%) answered water borne-diseases. Of these, 219 (56.7%) used household treatment methods, and 80 (20.7%) were not used. Methods 91 (23.6%) were used for chlorination, 61 (15.8%) for boiling, 45 (11.7%) for filtration, and 22 (5.7%) for solar disinfection. In addition, the majority of the participants were practiced water for chlorination 91 (23.6%) as treatment.

Table 4. Knowledge level and methods of household water treatment.

Variable	Frequency (%)	Variable	Frequency (%)
Knowledge of household		Contamination results	
No	114 (29.5)	Diarrheal disease	226 (58.5)
Yes	272 (70.5)	Infant mortality	105 (27.2)
Objectives of HWT		Malnutrition	36 (9.3)
Prevent diarrheal disease	163 (42.2)	Water-borne diseases	19 (4.9)
Reduces infant mortality	76 (19.7)	Did you use any method	
Reduces water porn disease	32 (8.3)	No	80 (20.7)
Did you know causes of		Yes	219 (56.7)
No	124 (32.1)	How many methods use?	
Yes	262 (67.9)	Chlorination	91 (23.6)
		Boiling	61 (15.8)
		Filtration	45 (11.7)
		Solar Disinfection	22 (5.7)

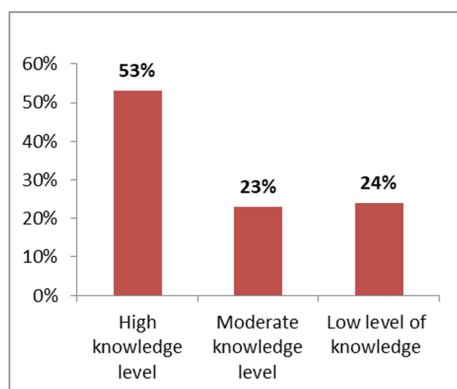


Figure 1. Level of knowledge.

Figure 1. Knowledge scores of household-level water treatment were divided into three main categories: high knowledge level, moderate knowledge level, and low-level knowledge. The high knowledge level was 205 (53%), the moderate knowledge level was 88 (23%), and 93 (24%) had a low level of knowledge, respectively. However, the majority of the residents in the study location have sufficient knowledge of household water treatment. Figure 2. Focused on the practice level of household water treatment, two categories based on which are good practice and poor practice. Also, the group of good practices was 281 (73%),

while the poor practices group was 105 (27%). Therefore, the majority of residents practiced the accurately.

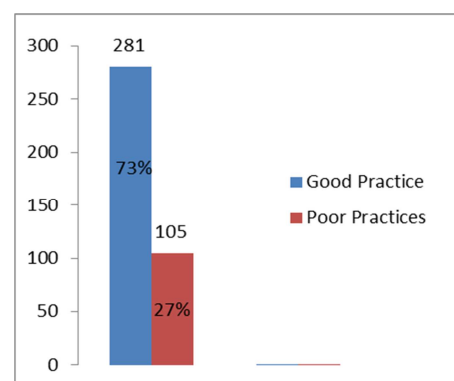


Figure 2. Knowledge practices.

3.5. Association Between Socio-demographic and Knowledge Level

The results in table 5 show that the husband's age, marital status, occupation, and education were found to be significant. Participants aged 16 to 39 years have more knowledge than 40 to 86 years (OR 0.652, 95%CI 0.424-0.999).

Unmarried respondents have more knowledge than married respondents (OR 0.342, 95%CI .212- .554). The

employed respondents have more knowledge than the unemployed respondents (OR 1.611, 95%CI 1.040-2.495).

The educated husbands have more knowledge than the uneducated husbands (OR 0.534, 95%CI .305- .936).

Table 5. Association between socio-demographic and knowledge level.

Variables	Knowledge		OR	95%CI	P-Value
	High N%	Low N%			
Age					
16-39 yrs	187 (48.4%)	71 (18.4%)	.652	.424 - 1.002	.051
40-86 yrs	106 (27.5%)	22 (5.7%)	1		
Marital status					
Married	24 (6.1%)	8 (2.1%)	.342	.212 -.554	.001
Un married	269 (69.6%)	85 (22%)	1		
Sex					
Male	125 (32.4%)	41 (10.6%)	.993	.663 - 1.487	.974
Female	168 (43.5%)	52 (13.5%)	1		
Educational Status					
Educated	234 (60.6%)	72 (18.7%)	.797	.529	- 1.201
Un-educated	59 (15.35%)	21 (5.4%)	1		
Occupation					
Employed	237 (61.4%)	62 (16.1%)	1.611	1.040 - 2.495	.033
Un-employed	56 (14.5%)	31 (8.0%)	1		
Education of husband					
Educated	109 (28.2%)	30 (7.8%)	.534	.305 -.936	.028
Un educated	58 (15.0%)	25 (6.5%)	1		
Education of wife					
Educated	98 (25.4%)	30 (7.8%)	1.143	.629 - 2.079	.661
Un-educated	24 (6.2%)	10 (2.6%)	1		
Family size					
Less than 10	191 (49.55%)	71 (18.4%)	.436	.282 -.673	.000
More than 10	102 (26.4%)	22 (5.7%)	1		
Monthly income					
Less than 100\$	228 (59.7%)	85 (22.0%)	.752	.496 - 1.142	.181
More than 100\$	65 (16.8%)	8 (2.1%)	1		

*= Significant where P-value < 0.05, OR= Odds ratio, CI= Confidence interval.

4. Discussions

The majority of respondents, 291 (75.4%), used plastic containers for water storage at a household level, while 48 (12.4%) used clay pots, followed by 47 (12.2%) cement tanks. Most containers used for water storage are plastic containers because of their availability and low cost. Residents who have containers were 227 (58.8%). Among 114 (29.5%), two containers were found. The number of people who practice boiling water was relatively low (15.8%). Compared to another study conducted in India that highlighted around 60% of the knowledge of boiling water, followed by chlorination (27%) and membrane filtering at (22.4%) [13]. In the Warta-Nabada district, the filtration rate was (11.7%) and only (5.7%) used solar disinfection for drinking and domestic water. Another study revealed that the level of knowledge on water chlorination was also comparable (23.6%) with that of the Myanmar study (10%) [14]. However, other research conducted in Somalia revealed that there was no variable association between latrine availability and household water treatment practices [11].

On the other hand, the respondents' ages in this study were between 16 and 39 years old, which has more knowledge than those ages between 40 and 86 years old (OR 0.652, 95%

CI 0.424-1.002). The unmarried participants have better knowledge than the married respondents (OR 0.342, 95%CI. 212-554). The employed participants have good knowledge compared to the unemployed respondents (OR 1.611, 95% CI 1.040-2.495). Therefore, educated husbands have more knowledge than uneducated husbands in household water treatment practices (OR 0.534, 95%CI .305- .936).

However, nearly half of mothers and caregivers (49.3%) understood household water treatment methods [15]. The current study highlighted the use of the chlorination method was (23.6%). The other study highlights that chlorinated water was associated with a 48% reduction in diarrhea [16]. These results indicate that the chlorination of water can be successfully carried out locally to improve the health of the population. The majority of the participants are interested in household water treatment (62.8%). The findings also revealed that (43.0%) of respondents were male, while (57.0%) were female. The population sample that collected the data was categorized into single, married, divorced, and widowed. The (39.1%) could not read, while 86 (22.3%) could read and write, but 69 (17.9%) were at the primary level, and 43 (11.1%) were secondary. Besides, the lowest portion, 37 (9.6%), were universities. The majority of respondents (31.3%) were housewives, while 90 (23.3%) were government employees, and (22.8%) were private-

sector employees. Furthermore, 16.3% were laborers, 5.2 percent were merchants, and farmers accounted for the minor proportion, around 4.0%. The husband's educational status (15.1%) was that he could not read and write, while (15.0%) could not read and write. The level of primary schools was (5.4%) and (11.9%) were secondary level. Nevertheless, 3.1% were Quranic level.

5. Conclusion and Recommendation

According to these results, it can be concluded there were significant variables for age, marital status, occupational, and education of the husband of the household water treatment practices in Mogadishu. When there was a high risk of acute water diarrhea or cholera, household water treatment methods were primarily related to drinking water chlorination, boiling, and filtration. The group of good practices was (73%), while the poor practices group was (27%). Nevertheless, the majority of residents practice the proper way. This study's findings suggest both a need for improving the handling and storage practices of drinking water at a household level and methods of water treatment practices for reducing health risks related to the drinking-water supply.

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