ASSESSMENT OF DRINKING WATER QUALITY OF DIFFERENT HOSPITALS IN RANCHI, JHARKHAND

ABSTRACT

Water is one of the natural resources, which are found in an adequate amount. It is an essential source for the existence of life on the planet earth. Water plays an important role in our health. It helps in bringing nutrient to cells, getting rid of wastes, protecting joints and organs and maintaining our body temperatures. Water supply to healthcare facilities is frequently an overlooked yet essential for safe patient care and can be manageable source of infections. This paper presents a study in drinking water quality of different hospitals in which water samples from 8 different hospitals in Ranchi district was collected and were analyzed for 10 physio – chemical parameters such as pH, Electrical conductivity, Temperature, Alkalinity, Chloride, Total hardness, Calcium hardness, Magnesium hardness, Turbidity and Total dissolved solids. All the water samples were within the permissible limits stated by both BIS and WHO.

Keywords:Drinking water quality, Hospital water, physio-chemical parameters, Ranchi.

1.INTRODUCTION

Water is one of the natural resources, which are found in an adequate amount. It is an essential source for the existence of life on the planet earth. It is widely used for various purposes such as drinking, washing, bathing, cleaning, cooking, irrigation, and other industrial and domestic uses. **(Miller, 1997)[1]**. Water is present in the atmosphere as water vapor, which condenses to form clouds, fog, mist, etc. The main sources of natural water are: Surface water, Underground water and above surface water, based on sources, water can further be classified into Rainwater, river, lake water, Spring, well water, ocean and seawater. **(Bhattacharyya, 2015)[2].**

Water plays an important role in our health. It helps in bringing nutrient to cells, getting rid of wastes, protecting joints and organs and maintaining our body temperatures. A safe water supply is the backbone of a healthy economy, yet is woefully under prioritized, globally. **(WHO,2015)[3].** Water supply to healthcare facilities is frequently an overlooked yet essential for safe patient care and can be manageable source of infections. Numerous healthcare-associated (HAI) outbreaks have been linked to contaminated water used for patient care particularly maternal and child health, hand washing, and cleaning of medical devices for reprocessing to name but a few. Good quality potable water is still an unmet need in many low- to middle-income countries. **(Mehtar,April2018)[4].**

2. MATERIALS AND METHODS

The present study “Assessment of drinking water quality of different hospitals in Ranchi, Jharkhand” was carried out in Ranchi. The details are as follows.

2.1 Sampling Area

Ranchi is the capital of the Indian State of Jharkhand. It was formed on 15 November 2000 by carving out the Bihar divisions Ranchi lies at 23°22′N 85°20′E near to the Tropic of Cancer. The city covers an area of 175 km2 (68 sq. mi) and its average elevation is 651 m above sea level.

2.2 Collection and Preservation of Samples

Water samples were collected during the month of January 2024 to May 2024 (5 months), from 8 different hospitals of Ranchi district. The samples were collected in clean air tight bottles without any contamination and were properly labelled according to its respective location notations.

2.3 Sampling frequency

Samples were collected and analyzed in every 30 days of interval during monitoring period.

2.4 Analysis of Collected Samples

All the experimental analysis were conducted in Biocrat Environmental Services Laboratory, Ranchi.

2.5 Sampling Sites

The water samples were collected from the selected hospitals for assessing the water quality for drinking purpose.

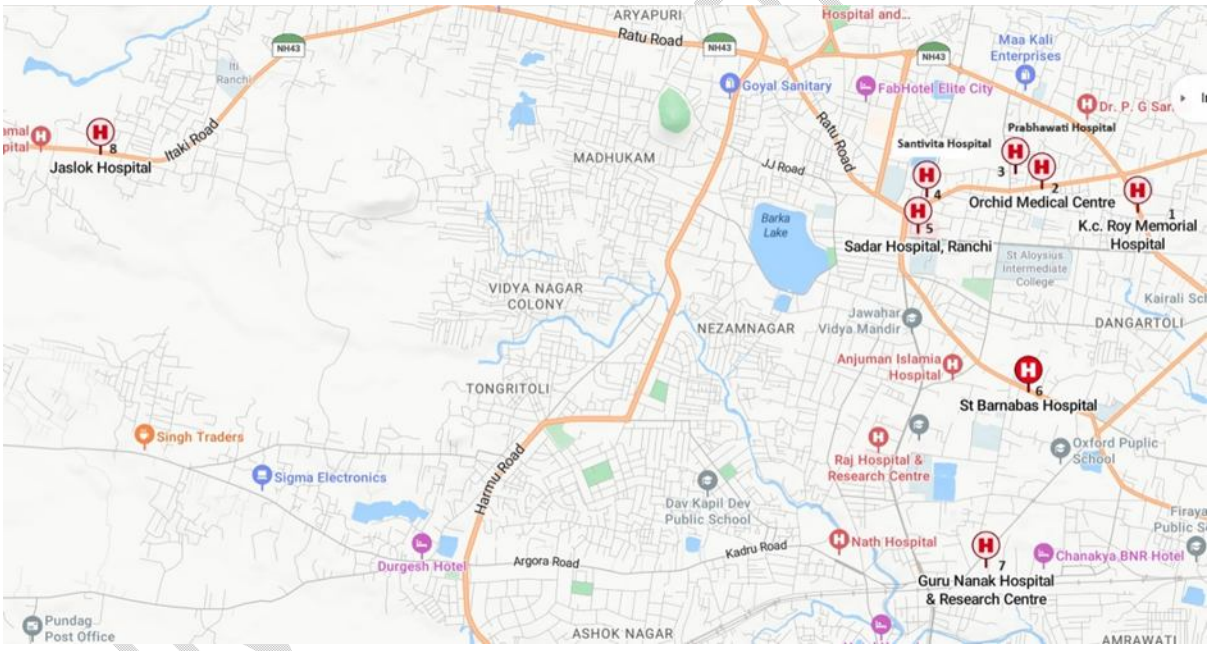

Figure 1. study area

2.6 Hospitals

H_1 = KC Roy Memorial Hospital **(Government Hospital)**

H_2 = Orchid Hospital **(Private Hospital)**

H_3 = Prabhawati Hospital **(Private Hospital)**

H_4 = Santevita Hospital **(Private Hospital)**

H_5 = Sadar Hospital **(Government Hospital)**

H_6 = Barnabas Hospital **(Government Hospital)**

H_7 = Guru Nanak Hospital **(Private Hospital)**

H_8 = Jaslok Hospital **(Private Hospital)**

2.7 Parameters Analyzed

Different parameters, signifying the quality of water at different sites were analysed by following methods.

2.8 Physico-Chemical Parameters of Water

Table 1: BIS (IS: 10500:2012), Standard for drinking water

SL.NO	Parameters	Desirable limits	Permissible Limits
1	pH	6.5-8.5	No relaxation
2	E.C (µs/cm)	100 (µs/cm)	2000 (µs/cm)
3	Temperature (ºC)	-	-
4	Alkalinity (mg/l)	200 mg/l	600 mg/l
5	Chloride (mg/l)	250 mg/l	1000 mg/l
6	Total Hardness (mg/l)	200 mg/l	600 mg/l
7	Calcium Hardness (mg/l)	75 mg/l	200 mg/l
8	Magnesium Hardness (mg/l)	30 mg/l	100 mg/l
9	Total Dissolve Solids (mg/l)	500 mg/l	2000 mg/l
10	Turbidity (NTU)	1 NTU	5 NTU

Table 2: WHO Standards for drinking water

SL.NO	Parameters	Desirable limits	Permissible Limits
1	pH	7.0-8.5	6.5-9.2

2	E.C (µs/cm)	150 (µs/cm)	2700 (µs/cm)
3	Temperature (ºC)	-	-
4	Alkalinity (mg/l)	200 mg/l	600 mg/l
5	Chloride (mg/l)	200 mg/l	600 mg/l
6	Total Hardness (mg/l)	100 mg/l	500 mg/l
7	Calcium Hardness (mg/l)	75 mg/l	200 mg/l
8	Magnesium Hardness (mg/l)	30 mg/l	100 mg/l
9	Total Dissolve Solids (mg/l)	500 mg/l	1000 mg/l
10	Turbidity (NTU)	1 NTU	5 NTU

3. Results and Discussion

pH: The maximum pH 7.24 was observed in H_5(Sadar Hospital) and the minimum pH 6.57 was observed in H_1(KC Roy Hospital). The safe range for drinking water pH levels is between 6.5 and 8.5. Water quality with high acidic and alkaline conditions have distinct effects on various water quality parameters. Water with a very low or high pH can be a sign of chemical or heavy metal pollution. **(Dewangan, 2023)[5]**

Electrical Conductivity: The maximum EC1.12µs/cmwas observed in H_1 (KC Roy Hospitaland the minimum EC 0.23µs/cm observed in H_7(Gurunanak Hospital). Conductivity measures water's ability to conduct electricity and indicates dissolved ionic solid concentration and salinity. High conductivity can cause corrosion, scale build-up, mineral-like taste in drinking water, and issues with dissolved solid concentration in agriculture. **(Xianhong, 2021)[6]**

Temperature: The maximum temperature 30.2ºC was observed in H_6 (Barnanas Hospital)and the minimum temperature 23.4ºC was observed in H_5(Sadar Hospital). Drinking water temperature can significantly increase or decrease during distribution from the source to the consumer.This change is strongly influenced by the weather, the depth of installation of transport and distribution pipes, the soil type, ground water levels, presence of anthropogenic heat sources and hydraulic residence times. At the building level, drinking water temperature can also be affected by the layout of the hot water installations. **(Agudelo, 2020)[7]**

Alkalinity: The maximum Alkalinity82.4 mg/l was observed in H_5(Sadar Hospital) and the minimum alkalinity 31.2mg/l was observed in H_7(Gurunanak Hospital). Alkalinity in water means presence of ions. It also indicates that the potential of hydrogen value of water is good. It has small clusters of water molecules and is good for health. **(Lal *et al,* 2022)[8]**

Chloride: The maximum chloride 93.4 mg/was observed in H_3(Prabhawati Hospital) l and the minimum chloride 14.2 mg/l was observed in H_7(Gurunanak Hospital). Chloride in the form of the Cl- ions is one of the major inorganic anions or negative ions in saltwater and freshwater. In drinking or potable water, water containing 250 mg/l of chloride may have a salty taste if the chloride came from sodium chloride. **(Khateeb, 2014)[9]**

Total Hardness: The maximum hardness353 mg/l was observed in H_1 (KC Roy Hospital) and the minimum hardness 128 mg/l was observed H_7(Gurunanak Hospital). The hardness in water is caused by polyvalent metallic ions from sedimentary rocks, seepage and runoff from soils. Calcium and magnesium are the two main ions causing hardness in water. **(Rehman*et al*, 2018)[10]**

Calcium Hardness: The maximum calcium hardness 95.8 mg/l was observed in H_1(KC Roy Hospital) and the minimum calcium hardness26.4 mg/l. was found in H_7(Gurunanak Hospital)Drinking water with high concentration of calcium has been associated with a lower risk of cardiovascular mortality in ecological and case control studies. **(Emilie *et al,* 2022)[11]**

Magnesium Hardness: The maximum Mg hardness 33.8 mg/l was observed in H_1(KC Roy Hospital) and the minimum Mg hardness 3.4 mg/l was observed in H_7(Gurunanak Hospital).

Turbidity: The maximum turbidity 4.47 NTUwas observed in H_2 (Orchid Hospital) and the minimum turbidity 0.26 NTU was observed in H_7 (Gurunanak Hospital). Turbidity, which is caused by suspended chemical and biological particles, can have both water safety and aesthetic implications for drinking-water supplies. It indicates the presence of pathogenic microorganisms and be an effective indicator of hazardous events throughout the water supply system, from catchment to point of use. **(WHO, 2017)[12]**

Total Dissolved Solids: The maximum TDS 734.6 mg/l was observed in H_1 (Sadar Hospital) and the minimum TDS 155 mg/l was recorded in H_7(Gurunanak Hospital). The concentration of total dissolved solids (TDS) present in water is one of the most significant factors in giving water taste. It also provides important ions such as calcium, magnesium, potassium, and sodium. **(Wang, 2021)[13]**

Table 3: Assessment of pH, EC, Temperature, Total Alkalinity and Chloride of Drinking water in Hospitals at Ranchi

Parameter →	pH	EC	Temp.	TA	Cl^-

Hospitals ↓		µs/cm	(ºC)	(mg/l)	(mg/l)
KC Roy	6.578	1.1206	25.8	61.6	50.4
Orchid	6.614	1.0762	26.2	70	38.2
Prabhawati	7.074	0.8078	27.8	78	93.4
Santevita	6.728	0.7878	25.2	52	15.4
Sadar	7.234	0.5584	23.4	82.4	80
Barnabas	6.686	0.9138	30.2	40.8	52.4
Gurunanak	7.068	0.2388	28.6	31.2	14.2
Jaslok	6.734	0.9364	26.2	67.2	17

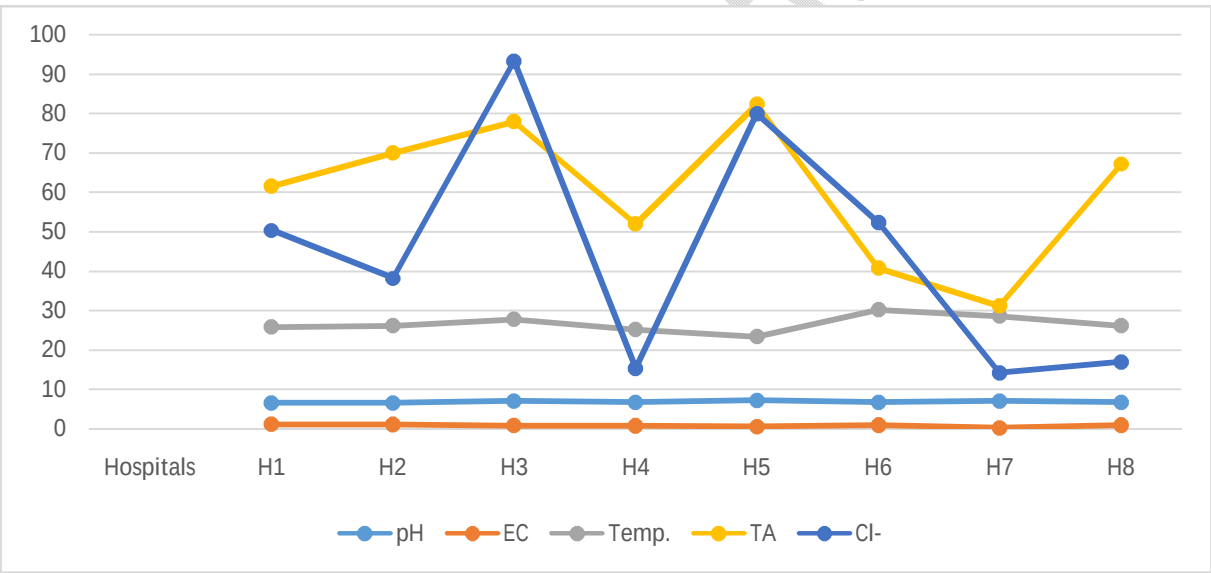

Fig 2: Assessment of pH, EC, Temperature, Total Alkalinity and Chloride of Drinking water in Hospitals at Ranchi

Table 4: Assessment of Total Hardness, Calcium Hardness, Magnesium Hardness, Turbidity and Total Dissolved Solids of Drinking Water of Hospitals at Ranchi

Parameter → / Hospitals ↓	TH (mg/l)	Ca^{2+} (mg/l)	Mg^{2+} (mg/l)	Turbidity NTU	TDS (mg/l)
KC Roy	353.8	95.8	33.8	2.752	734.6
Orchid	316	82.6	28.4	4.476	693.4
Prabhawati	263.4	68.8	18.2	2.57	521
Santevita	222.4	58.4	20	2.602	506.2
Sadar	148.6	47.4	12.6	4.342	357.6
Barnabas	268.4	77.4	23.2	1.268	597
Gurunanak	128	26.4	3.4	0.268	155
Jaslok	290.8	88	18.2	0.804	610.2

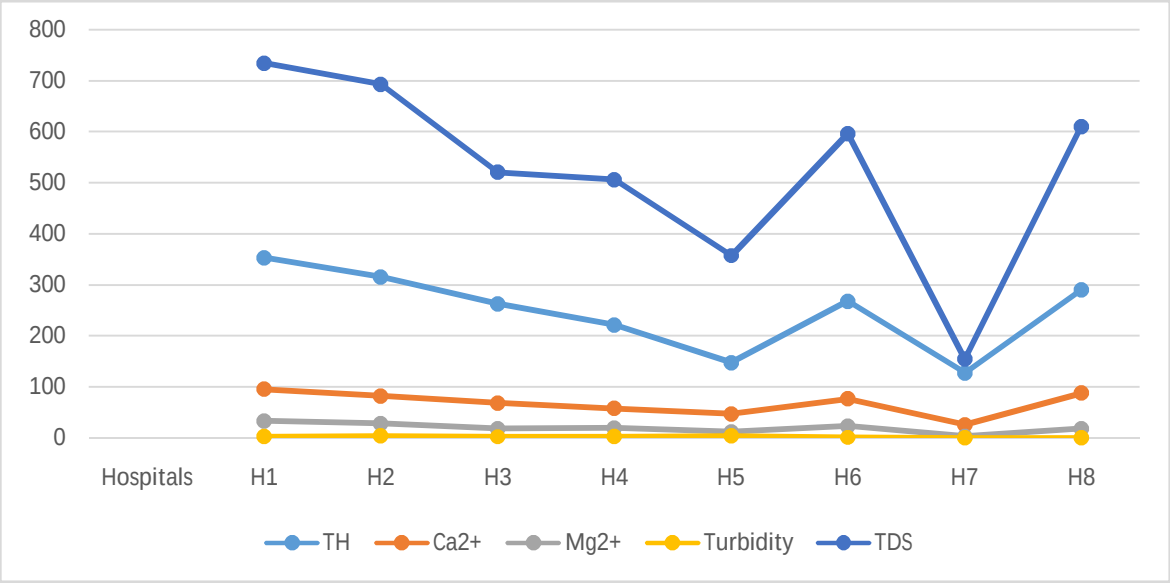

Fig 3:Assessment of Total Hardness, Calcium Hardness, Magnesium Hardness, Turbidity and Total Dissolved Solids of Drinking Water of Hospitals at Ranchi

4. CONCLUSION

The present research work assessment of drinking water quality of different hospitals in Ranchi, Jharkhand was the concern expressed for deterioration in drinking water quality. It isobserved that the analyzed parameters of drinking water from 8 different hospitals at Ranchi showed that the pH, EC, Temperature, Alkalinity, Chloride, Total hardness. Ca hardness, Mg hardness, Turbidity and TDS values were all within the desirable and permissible limit as per the standards given by BIS & WHO. The water samples are fit for drinking and other purpose as well as safe for patients and the hospitals staffs.

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