ORIGINAL RESEARCH PAPER

Management

WATER QUALITY MONITORING INFRASTRUCTURE FOR TACKLING WATER BORNE DISEASES IN THE STATE OF MADHYA PRADESH, INDIA AND ITS IMPLICATION ON SUSTAINABLE DEVELOPMENT GOALS (SDGS)

KEY WORDS: Water Quality, Water-borne diseases, Water Quality Laboratories, Field Test Kits, SDGs, MDGs

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ABSTRACT

It is estimated that around 37.7 million Indians are affected by waterborne diseases annually, 1.5 million children are estimated to die of diarrhoea alone and73 million working days are lost due to waterborne disease each year. The resulting economic burden is estimated at $600 million a year.Owning the largest share, India has a significant role to play in achieving global Sustainable Development Goals. In such scenario, monitoring of drinking water quality and its improvement play significant role in ensuring public health and reducing economic burden. Taking cue from this, a study was designed to assess the efficiency of water quality laboratories establishedunder National Rural Drinking Water Programme in the State of Madhya Pradesh.The study concluded that none of the 56 laboratories was able to perform minimum 3000 tests per year (Annual Analysis Load). In a State, which tops the list of States in country with highest Infant Mortality Rate (IMR), the drinking water quality assessment infrastructure is not in a position to monitor the water quality. This paper presents the findings of qualitative assessment of 56 water quality laboratories in 16 districts and also comparative assessment of laboratory based and Field Test Kit based water quality testing in rural areas.

INTRODUCTION

Sources of good quality water for drinking and domestic use, whether surface or groundwater, are fundamental to human health. Water quality is naturally influenced by the climatological and geochemical location of the water body through temperature, rainfall, leaching, and runoff of elements from the Earth's crust. Consumption of water containing pathogens or elements that are potentially toxic can lead to health impacts ranging from discomfort to death (UNEP, 2016).Though the global Millennium Development Goals (MDGs) target for drinking water was met in 2010, 663 million people still lack improved drinking water sources.96% of the global urban population uses improved drinking water sources, compared with 84% of the rural population. 84% of the people who don't have access to improved water, live in rural areas, where they live principally through subsistence agriculture. Eight out of ten people still without improved drinking water sources live in rural areas. In developing countries, as much as 80% of illnesses are linked to poor water and sanitation conditions. (JMP 2015). Besides the current target (achieved) was based solely on access to an improved facility, but the definition of 'improved' does not take into account other important parameters such as drinking water quality, adequacy of quantities available for domestic or productive uses, distance to water source, time spent to access and use facilities, reliability and maintenance of services, affordability and social barriers to access, safe disposal and treatment of wastewater. Furthermore, any recalibration of targets and/or adoption of stricter definitions of improved would result in significantly higher estimates of population receiving services below a basic standard. (Slaymaker, 2012) According to WHO, 2015, 844 million people lack even a basic drinking-water service, including 159 million people who are dependent on surface water. Globally, at least 2 billion people use a drinking water source contaminated with faeces. Contaminated drinking water is estimated to cause 502 000 diarrhoeal deaths each year.

With 78.5 million people, India is at top among countries with largest number of people without access to safe water. Most of those people are living on around £3 a day. India is also among top 10 worst countries for household water access. Besides these distinctions, the country has the State of Madhya Pradesh with highest infant mortality rate (IMR) (57 deaths of children less than one year of age per 1,000 live births) (SRS, 2014), which is worse than some of the African countries often cited for poor health indices. According to World Bank, the IMR for Rwanda for the same year was 33, Ethiopia 43 and Zambia 45. Increased access to improved water sources is significantly associated with decreased under-five mortality rate, decreased odds of under-five mortality due to diarrhoea, decreased IMR, and decreased odds of MMR. Access to water and sanitation independently contribute to child and maternal mortality outcomes. (Cheng et. al., 2013)Economic benefits of investing in water and sanitation are considerable: they include an overall estimated gain of 1.5% of global GDP and a US$ 4.3 return for every dollar invested in water and sanitation services, due to reduced health care costs for individuals and society, and greater productivity and involvement in the workplace through better access to facilities. (WHO, 2018)If the world is to seriously address the Sustainable Development Goals (SDGs) of reducing child and maternal mortality, then improved water and sanitation accesses are key strategies.

Policy Framework governing water quality in rural India

The Twelfth Five Year Plan (2012-2017) (GoI 2011) has placed a greater thrust on coverage of the water quality affected habitations, in order to address water quality issues in rural areas. As per NRDWP Guidelines (Water Quality), (MDWS 2013) 20% of the annual NRDWP funds are allocated for tackling water quality problems to enable rural communities to have access to potable drinking water. The NRDWP guidelines further stipulates that 3% of NRDWP funds on a 100% Central share basis are to be used for water quality monitoring and surveillance activities at the field level and for setting up and operating water quality testing laboratories at the state, district and sub district levels.

The Bureau of Indian Standards (BIS) has specified drinking water quality standards in India to provide safe drinking water to the people. As per Bureau of Indian Standards, IS-10500-2012, (BIS 2012) water is defined as unfit for drinking purpose, if it is bacteriologically contaminated (presence of indicator bacteria particularly E-coli, viruses etc.) or if chemical contamination exceeds maximum permissible limits (e.g. excess fluoride [>1.5mg/l], Total Dissolved Solids (TDS) [>2,000mg/l], iron [>0.3 mg/l], manganese [>0.3 mg/l], arsenic [>0.05mg/l], nitrates [>45mg/l] etc.).

The Drinking Water Quality Monitoring protocol of Government of India (MDWS Protocol 2013) describes specific requirements for monitoring drinking water quality in rural areas. In addition, this document also includes requirements for setting-up laboratories at State, District and Sub-district level and quality control for regular testing and surveillance of drinking water sources. The purpose of this document is to describe various elements of laboratory management practices.

Following the various provisions in the Protocol and with funding provided by Government of India, 51 District laboratories, 3 Block laboratories and 106 Sub-divisional laboratories have been established in 51 districts of the State of Madhya Pradesh. In the month of July, 2014 an assessment of implementation of various provisions of Protocol with regard to (1) availability of space for analytical purpose (2) availability of office equipment, instruments, glassware and chemicals (3) availability of human resource (4) sampling (5) use of field test kits (6) safety measures was undertaken. The objective of the assessment was to find gaps in the above mentioned six areas and also to suggest measures, so that each laboratory achieves the target of minimum 3000 water quality tests per year.

Table: 1 – Habitation status based on Lab testing – Madhya Pradesh State (As on 31st March, 2014)

	Total No. of Habitations	No. of habitations, where all sources have been tested		No. of habitations, where no source tested		No. of habitations, where 75% sources have been tested	
	Number	Number	%	Number	%	Number	%
India	1692133	113781	6.72	1088514	64.33	155583	9.19
Madhya Pradesh	127169	22924	18.03	69918	54.98	32052	25.20
16 districts	59087	11217	18.98	34231	57.93	14545	24.62

Source: www.indiawater.gov.in

It is evident from Table 1, that in the State of Madhya Pradesh only in 22924 (18.03%) habitations, all sources have been tested in laboratories, whereas in case of 16 districts it is 11217 (18.98%). State-wide number of habitations, where no source has been tested in laboratory is 69918 (54.98%), in case of 16 districts, it is 57.93%. Number of habitations, where 75% of sources have been tested in laboratories are 32052 (25.20%) in State and 14545 (24.62%) in 16 districts. It is a point of concern that in 69918 (54.98%), quality of water and potential risks are not known either to nodal department nor to common people i.e. water users.

METHODOLOGY

The Uniform Drinking Water Quality Monitoring Protocol prescribes various provisions with regard to availability of space for analytical purpose, availability of office equipment, instruments, glassware and chemicals, availability of human resource, sampling, use of field test kits, and safety measures for water quality laboratories. Based on various provisions of Protocol, a structured questionnaire was designed. The questionnaire was used to collect data from Chief/Head Chemists of all 56 water quality laboratories in 16 districts. (Annexure – I) The data collected in each category was analysed against the respective provision in the protocol. For example absence of separate analytical space for biological testing of water samples against space as prescribed in Protocol highlights a gap. Absence of office equipment such as computer and internet connectivity highlights a gap in data entry and so on. Besides, a comparative analysis of laboratory based and field based water quality analysis was also undertaken.

RESULTS AND DISCUSSION

This section highlights primary data collected from 56 laboratories against prescribed provisions in Protocol. Column 1 depicts provision prescribed in the protocol, whereas Column 2 & 3 show data collected from laboratory staff on the status of respective provision of Protocol. The information has been analysed in five categories altogether.

Table 2: Provision Vs Survey data of qualitative assessment of Water Quality Testing Laboratories

Categories	As prescribed in Protocol	Survey data (% of Labs) 2		Figure
	1			3
		Yes	No	
Space	Space for Analysis (District level 60m^2 including 20m^2 for bio & Block level 50m^2 including 20m^2 for bio)	26.79	73.21	1
	Separate space for biological testing	17.86	82.14	
	Space for storage (in m^2) (District - 25 & Block - 20)	12.50	87.50	
	Space for office & Library (in m^2) (District - 15 & Block - 10)	12.50	87.50	
	Total Space requirement (in m^2) (District - 100 & Block - 80)	25.00	75.00	
Office Equipment	No. of computers (District -1, Block -1)	41.07	58.93	2
	Internet	39.29	60.71	
	No. of UPS (Atleast 1)	30.36	69.64	
	Inverters (Back up time = 3 hours) (District -2 Block -1)	16.07	83.93	
	Printer	37.50	62.50	
	Telephone Facility	28.57	71.43	
	Fax	3.57	96.43	
Minimum Requirement	Instruments	48.21	51.79	3
	Glassware	82.14	17.86	
	Chemicals	57.14	42.86	
	Air-conditioner	10.71	89.29	
Human Resource	Chemist/Water Analyst	75.00	25.00	4
	Microbiologist/ Bacteriologist	21.43	78.57	
	Laboratory Assistant	51.79	48.21	
	Lab Attendant	14.29	85.71	
	Data entry operator	17.86	82.14	
	Person engaged exclusively for sample collection	9.00	91.00	5
	Mobility allowance to Sample Collectors	8.93	91.07	
Sampling	Availability of written code / guidelines for sample collection in laboratories	52.00	48.00	6
	Retesting of positively tested samples for analysis validity and confirmation of results	66.07	33.93	7
	Maintaining record of test results	60.71	39.29	8

Field Test Kits	Purchase of FTKs in last one year	26.79	73.21	9
	Distribution of FTKs to Gram Panchayats	25.00	75.00	10
	Checking FTKs for reliability and validity of testing	37.50	62.50	11
Safety Measures	Staff awareness on precautions with hazardous chemicals	82.14	17.86	12
	Staff awareness on precautions with hazardous equipment	85.71	14.29	
	Availability of fire extinguisher	10.71	89.29	
	Availability of First-Aid kit	26.79	73.21	
	Fume hood in the laboratory	7.14	92.86	

A. Availability

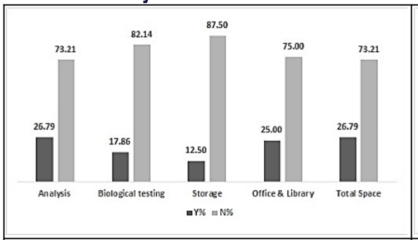

Figure 1: Availability of space in laboratories

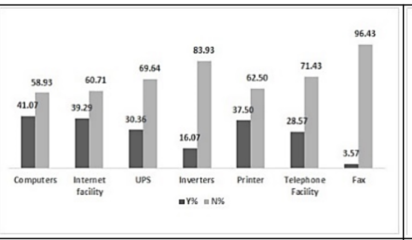

Figure 2 Availability of Office Equipment in laboratories

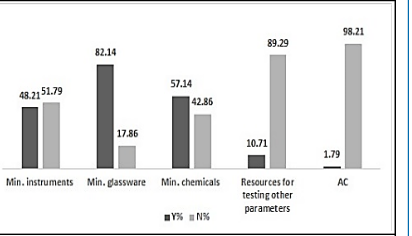

Figure 3: Availability of Instruments / glassware / chemicals

Out of 56 laboratories, 73.21% laboratories do not conform to the space norms for analytical and related purposes as prescribed in protocol. 82.14% laboratories do not have separate space for biological testing of water samples as prescribed. In 87.50% laboratories, sufficient space is not available for storing necessary chemicals, instruments, office equipment and furniture. 58.93% laboratories devoid of computer and 60.71% laboratories don't have internet facility. 71.43% laboratories don't have the telephone and fax facility.

The minimum instruments, glassware and chemicals required for testing of 13 basic parameters are not available in 51.79%, 17.86% and 42.86% laboratories respectively. 89.29% laboratories do not have sufficient resources for testing of parameters (other than 13 basic parameters) such as heavy metals.

B. Human Resource

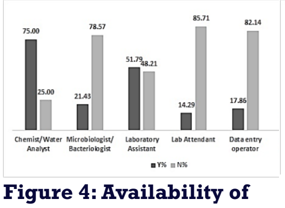

Figure 4: Availability of human resource in laboratories

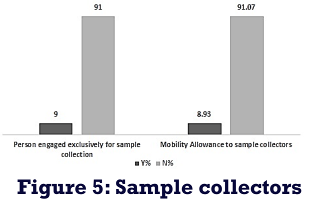

Figure 5: Sample collectors and mobility allowance

Though survey data show posting of Chemist/Water Analyst in 75.00% laboratories, but these are not the regular staff. 78.57% laboratories don't have microbiologist/ bacteriologist for bacteriological testing of samples and their interpretation. In 48.21% laboratories, Laboratory Assistants are not posted to assist Chemist/Water Analyst in analytical work. 85.71% laboratories don't have Lab attendant. The posts of data entry operators for entering analysis data are vacant in 82.14% laboratories. 91% laboratories don't have Sampling Assistants for collection, transportation and coding of sample. In 91.07% laboratories, sample collectors are not paid mobility allowance for meeting basic travel expenses in sample collection.

C. Sampling

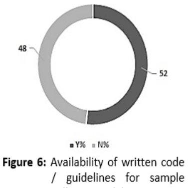

Figure 6: Availability of written code / guidelines for sample collection in laboratories

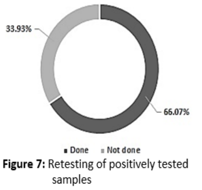

Figure 7: Retesting of positively tested samples

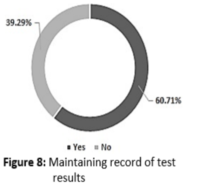

Figure 8: Maintaining record of test results

48.21% laboratories don't have written code/guidelines to be followed during collection of samples. (Figure 6) 66.07% laboratories reported to have conducted retesting of positively tested samples for validation, (Figure 7) but lab staff failed to produce any documentary evidence in support of their claim. In 39.29% laboratories, though staffs maintain separate register for positively tested samples, it was not found updated in 62.50% such cases. (62.50% of 39.29%). (Figure 8)

D. Field Test Kits (FTKs

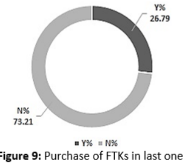

Figure 9: Purchase of FTKs in last one year

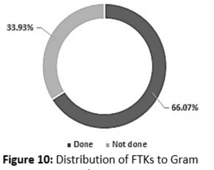

Figure 10: Distribution of FTKs to Gram Panchayats

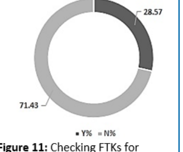

Figure 11: Checking FTKs for reliability and validity

In last one year (prior to survey), 73.21% laboratories did not purchase FTKs for distributions to Gram Panchayats. (Figure 9) Though 26.79% laboratories reported to have purchase FTKs in last year, but out of that only 37.50% laboratories distributed them to Gram Panchayats. (Figure 10) In 71.43% laboratories, FTKs are not tested for validity and reliability of testing.

E. Safety Measures

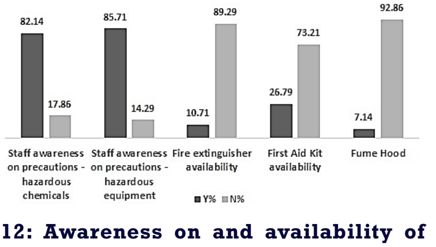

Figure 12: Awareness on and availability of safety measures in laboratories

The staff in 82.14% and 85.71% laboratories were found aware on safety measures while dealing with hazardous chemicals and equipment respectively, but requisite safety measure viz. fire extinguishers, first-aid kits and fume hood were not available in 89.29%, 73.21% and 92.86% laboratories respectively.

Table 3: Comparative assessment of Laboratory based and Field Test Kit based water quality testing

S. No.	Parameter	Laboratory based testing	Field Test Kit based testing*
1	Accuracy	More	Less

2	Result interpretation	Requires specific skills	Not necessarily
3	Ability to conduct range of tests	High	Low
4	Replenishment frequency	Less	More
5	Cost per sample testing	More	Less
6	Infrastructure required	More	None
7	Space requirement	More	Less
8	Availability	Fixed point	Mobile
9	Sample Collection	Transportation required	On the spot
10	Safety measures requirements	Yes	Not much

*** FTKs distributed to Gram Panchayats under National Rural Drinking Water Programme in rural areas of India**

CONCLUSION

It is evident from data presented in Table 2 that water quality testing laboratories suffer from various short coming sincluding space crunch, devoid of office equipment, insufficient instruments/Glassware/Chemicals, dearth of qualified human resource, faulty sample collection & record maintenance and insufficient safety measures etc. Besides there is lack of community participation especially in water testing mechanism through FTKs. Because of this dismal status of State run laboratories, none of the 56 laboratories is able to perform target of 3000 tests per year i.e. Annual Analysis Load. Sample transport and labour for sample collection and analysis together constitute approximately 75% of marginal costs, which exclude capital costs, which are together a major portion of the overall cost of monitoring. (Crocker et.al. 2014)

Though FTKs offer an easier way of testing water quality in field, they also have its own demerits. These kits are generally used for basic analysis such as water temperature, transparency and pH. The detection of specific contaminants by onsite tests is however more difficult. Although the detection limits are good, the analytical quality control of these tests may be questionable and their reproducibility are often limited too. The costs of field based tests may vary widely too, from as low as ~$0.5 up to ~$11.3. Considering the large amount of samples that need testing before a water source can be safely consumed, and the relatively large amount of samples needed for frequent monitoring, these tests can also become costly and unpractical.

Space crunch putting laboratory's staff and performance at risk.

The unavailability of exclusive space especially for biological testing makes samples vulnerable for contamination, which in turn decreases the reliability of test results. Unavailability of sufficient space for storing necessary chemicals, instruments, office equipment and furniture is creating difficulty for staff to perform and it also posing threat to them. (Figure 1)

Devoid of Office Equipment

Because of unavailability of computer and internet facility, laboratory staff have to visit PHE Division or Sub-division offices, which simply wastes time and energy and it is also responsible for delayed and poor data entry. Lack of telephone and fax facility results in irregular and delayed communication among different stakeholders such as sample collectors in field, community water users and higher officers. (Figure 2)

In-sufficient instruments/Glassware/Chemicals for testing of 13 basic parameters and heavy metals

Unavailability of minimum instruments, glassware and chemicals required for testing of 13 basic parameters and heavy metals causing laboratories to under-perform. In absence of air-conditioner or cooling facility, it is impossible to maintain optimum temperature for achieving accuracy in testing results. Because of above gaps, none of 56 laboratories is able to achieve minimum target of 3000 tests per year. (Figure 3)

Dearth of qualified Human Resource

Lack of regular chemist/Water Analyst in all 56 laboratories is making difficult for undertaking analytical work. Absence of microbiologist/bacteriologist creating problem in bacteriological testing of samples and their interpretation. It poses more threat in case of drinking water sources having damaged infrastructure like dilapidated hand pump apron, associated drainage systems and leaky distribution lines. (Figure 4)

Faulty sample collection and record maintenance

Sample transport and labour for sample collection and analysis together constitute approximately 75% of marginal costs, which exclude capital costs, which are together a major portion of the overall cost of monitoring. (Crocker et.al. 2014)Because of unavailability of Sampling Assistants in laboratories, work of sample collection, transportation and coding is severely affected. Not receiving payment for collecting and delivering samples even for meeting basic travel expenses is discouraging sample collectors. This ad-hoc arrangement for sample collection has a negative effect on the performance of laboratories.(Figure 5) Absence of written code/guidelines for sample collection is responsible for violation of sampling protocols and it also raises serious questions on the accuracy of test results. (Figure 6) Not retesting positively tested samples for validation raises doubts on the test results (Figure7). Poor documentation especially of positively tested samples leaves no scope for future reference.

Non-existing community participation in water quality monitoring through Field Test Kits (FTKs)

The FTKs serve the purpose of initial screening of contamination but also are an effective tool for awareness generation amongst the community to consume only safe drinking water. Since majority of laboratories did not purchased FTKs in last one year (prior to survey), (Figure 9) it raises serious question on community participation in water quality monitoring through FTKs. No testing of FTKs in laboratories for checking their validity and reliability for water quality testing results in wastage of resources. (Figure 11)

In-sufficient Safety Measures

Though survey data indicate high level of awareness amongst laboratory staff on the safety measures while dealing with hazardous chemicals and equipment, in majority of laboratories absence of safety measures such as fire extinguishers, first-aid kits and fume hood in laboratories is posing threat to the safety of laboratory staff. It also puts psychological stress on the staff while working in laboratories. (Figure 12)

Because of above gaps, none of the 56 laboratories in 16 districts is able to perform minimum 3000 water quality tests per year (Annual Analysis Load).

RECOMMENDATION

Screening of areas and identification of water quality hot-spots

A detailed analysis of areas for water quality needs to be done, based on which areas having higher incidence of water quality issues can be identified and recognised as hot-spots. In these hot-spot areas, investment need to be made on establishing sophisticated water quality testing laboratories. In remaining areas with lower incidences of water quality issues, simpler field based technologies can be used. Giving uniform targets for water quality testing to all water quality testing facilities is not logical and scientific.

Inter-departmental coordination for space sharing or availability

Since most of the District and Sub-district offices of Public Health Engineering Department are not having their own lands except for offices, land may be availed on lease from District Land Revenue Department.

Development of procurement system

Minimum chemicals, glassware, instruments and office equipment as prescribed in protocol must be made available in laboratories. For this a procurement system may be put in place. This system will help laboratories in periodic need assessment, product quantification and forecasting, budgeting and procurement planning. The procurement function may also be outsourced to an external specialised agency.

Recruitment of qualified human resource and their capacity building

In order to achieve efficiency in functioning of laboratories, qualified staff in sufficient number must be posted on regular basis. If it is not possible for the entire State for the want of finances, it may be ensured at least for districts having more number of quality affected sources. For capacity building of laboratory staff and community water users, capacity building module based on "Uniform Drinking Water Quality Monitoring Protocol" of Government of India comprising salient features may be used.

Developing cadre of sample collectors and their capacity building

Amongst community members, a group of people especially youth may be selected for developing them as a cadre of sample collectors. Their services may by incentivised through pecuniary or non-pecuniary measures. Capacity of this cadre may also be built on the use of FTKs for preliminary investigation of water samples. Ground staff of other departments such as ASHA, Anganwadi Workers, School Teachers, GP members and Social Workers etc. may also be involved in collection of water samples from field.

System development for random checking of positively tested samples

A separate register may be maintained for positively tested samples. From this register, samples may be chosen on random basis and may be retested. This random checking of samples should be made a routine activity for laboratory staff. Results of positively tested samples need to be conveyed to the staff of Public Health Engineering department for taking remedial actions. Water users fetching water from such sources must be informed immediately and necessary actions should be initiated.

Availability of safety measures in laboratories

Safety measures in sufficient quantity should be made available in laboratories for the safety of laboratory staff. Standards Operating Procedures (SoPs) to be followed during emergencies situations may also be developed and staff should be oriented on the same.

Technological intervention for real time data and information management

Considering the dynamic nature of water sources and prevalence of water-borne diseases, it is very difficult for nodal department/agency to monitor and maintain the water resources and schemes spread over a large geographical area. This herculean task may be made simple and effective with the involvement of local water user communities. Use of FTKs by local community provides an excellent opportunity for this kind of participation. But it has some limitations such as availability of FTKs, replenishment cost and frequency etc. The modern Information and Communication Technology (ICT) for information sharing may also be applied in the field.

R&D onalternative and affordable ways of testing water quality

Government must invest on innovative technologies for water testing, which are precise and affordable. The microbial fuel cell (MFC) technology is one of those technologies, which has potential for the rapid and simple testing of the quality of water sources. MFCs have the advantages of high simplicity and possibility for onsite and real time monitoring. Depending on the choice of manufacturing materials, this technology can also be highly cost effective. (Choularet.al., 2015)Typical low-tech, portable, field test methods for chemical water quality monitoring such as Test Strips, Color Disk Kits or Hand-held Digital Instruments can also be used. (Lawson, 2017)Sobsey, 2018 outlined the ideal characteristics of a microbial test for water quality monitoring on a limited budget, which are portable, low-skill, self-contained, lab-free, and electricity-free. It should be available globally at a cost of less than $0.10 (USD) per test, and it should be easy to interface with data reporting and communications technologies, but these characteristics can be applied for chemical test of water quality as well.

Upgradation of laboratories to national or global standards

National Accreditation Board for Testing and Calibration of Laboratories (NABL) is a Constituent Board of Quality Council of India. NABL has been established with the objective to provide Government, Industry Associations and Industry in general with a scheme for third-party assessment of the quality and technical competence of testing and calibration laboratories. Some of the laboratories of the State may be thought of upgrading to the NABL standards and may be used for exposure and training purposes.

There are certain risk factors that are associated with increased mortality and morbidity. The unsafe water and lack of sanitation are included in those preventable risk factors. Unsafe water supplies and inadequate levels of sanitation and hygiene increase the transmission of diarrhoeal diseases (including cholera), trachoma, and hepatitis. (World Health Statistics, 2015, WHO).

In such State, the infrastructure which is responsible for assessing and monitoring the water quality is in dismal condition. Though the world is on track to reach the drinking water target but projected to miss the sanitation target if trends remained unchanged, global rate of progress will be negatively influenced especially by poor progress in populous countries like China and India. (JMP, 2015)

In order to reduce the rates of important health indicators such as IMR and MMR, strengthening of water quality monitoring infrastructure is of utmost important. If done properly, this would have positive impact on global goals such asSDGs, because India has a large share in these goals to be achieved by the year 2030.

List of districts and number of laboratories assessed in the State of Madhya Pradesh, India

S. No.	District	District Laboratories	Sub-division Laboratories
1	Alirajpur	1	2
2	Barwani	1	1
3	Chhatarpur	1	3
4	Damoh	1	2
5	Dhar	1	4
6	Dindori	1	2
7	Jabalpur	1	2
8	Jhabua	1	1
9	Mandla	1	4
10	Panna	1	1
11	Rewa	1	4
12	Sagar	1	4
13	Satna	1	3
14	Sehore	1	3
15	Sidhi	1	2
16	Tikamgarh	1	2
Total		16	40

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