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MINISTRY OF HEALTH
LABORATORY ASSESSMENT

REPORT

FINAL DRAFT
13 AUGUST 1998

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1 0 Introduction

The Ministry of Health (MOH) main laboratory is presently equipped to conduct a variety of tests including coliform and fecal coliform bacteria, as well as many chemical and physical parameters The lab can test for metals and is equipped with AA and gas chromatography The laboratory is well equipped and staffed although some of the test equipment is aging and will shortly require replacement The MOH laboratory consists of the main facility along with eleven satellite labs (which perform coliform and fecal coliform testing) Analysis is routinely conducted on the system water, and samples are taken for analysis from residents' homes if requested The laboratory is operated within the Ministry of Health and supervised by Mr Mazen Khalil, Director of Environmental Health, assisted by Fatmeh Altawalbeh, chemist The overall governance of the laboratory pertaining to primary health care is under the direction of Dr Ashraf Alkurdi, Minister of Health, and Dr Adnan Abbas, Secretary General, Ministry of Health

The main laboratory conducts approximately 30 routine and 10 special microbiological tests per day Additional tests are conducted at the remote labs as well At the present time, the most probable number (MPN) method is used for coliform testing but the lab staff indicated an interest in developing the capability to use membrane filtration (MF) as an alternative technique

The laboratory is well run and maintained, the staff is capable and interested The quality control/quality assurance (QA/QC) procedures are acceptable including periodic split samples and check analysis The lab tracks samples well and follows proper procedures for data logging and reporting including turnaround time

2 0 General Observations

The lab has one AA and one GC and the associated equipment to perform MPN and other types of analysis including pH, odor, metals and specific ions Although the lab is not capable of testing for every drinking water parameter that is presently regulated, (none of the labs can test for every contaminant that may be found in drinking water) the tests that are being performed are generally sufficient to monitor the general public health acceptability of the water supply

The lab staff that we interviewed had an excellent understanding of analytical procedures, test limitations, and QA/QC procedures Periodically the laboratory receives QA/QC samples from WHO for check analysis This is excellent All the lab reports are reviewed by Mr Khalil before they are issued It is also our understanding that any unusual analytical results are immediately reported to the office of the Secretary General for immediate attention The lab staff were also very interested in learning more about some of the new analytical methods that have recently been developed including positive/negative testing for coliform bacteria

The analytical areas could use more work space for reagent storage, record keeping and general glassware storage Counter space is generally adequate but not sufficiently large to accommodate much more equipment

The staff indicated that additional training was needed in order to maintain a high level of quality service Training in a laboratory in normally conducted for three reasons, first, as a refresher for the staff to insure that proper methods are being followed, second, when a new piece of equipment is purchased to learn how to operate the machine, and, third, general laboratory training in safety, QA/QC procedures and laboratory practices We normally suggest routine refresher training for even experienced staff since water quality standards do change, allowable limits for individual parameters decrease and new types of equipment are constantly being developed. Therefore, it may be appropriate to coordinate an in-house training and refresher program with any lab upgrading that may be implemented.

The laboratory staff were all wearing proper lab coats but some safety equipment was not evident (it may have been available but not immediately apparent) Eye wash equipment or deluge showers should be placed in locations that are readily available in the event of an accident In addition we noticed that at all the laboratories visited (RSS, WAJ, Zai Plant and MOH) the technicians did not wear any eye protection. This should be discussed and considered as a staff recommendation

3 0 Water Quality Analytical Needs

The MOH lab, as with any lab has a mission It is our understanding that the mission of the MOH lab is to provide routine analytical testing of water, wastewater, etc to insure compliance with applicable standards or goals The goal in drinking water is to monitor those parameters that are considered the most immediate and critical to public health If an analysis suggests a problem then the responsibility of the laboratory is to report the results, in writing or, if urgent, verbally to the Office of the Ministry of Health for immediate action This is being done In the case of potable water the analytical needs center around meeting minimum standards for safety and palatability These needs, in our opinion, revolve around the following areas and are recommended as analytical goals for the laboratory in order to provide monitoring of drinking water quality Microbiological Analysis (coliform bacteria, fecal coliform), Ionic Analysis (copper, magnesium, iron, manganese, sodium, chloride, sulfate, zinc, boron, lead, cadmium, chromium, fluoride, aluminum, nitrate, nitrite, silver, sulfides), Physical Characteristics (turbidity, color, odor/taste, temperature), Chemical Analysis (hardness, oxygen, total dissolved solids, suspended solids, pH, LAS, ammonia, conductivity, cyanide, Heterotrophic Plate Count) We wish to emphasize that the present laboratory already has the capability to test for most of the recommended parameters We do not recommend that the laboratory upgrade for the analysis of the following parameters at this time, but space should be allocated for future reconsideration if deemed necessary later Radiological Analysis, Cryptosporidium (standard not yet developed and

the test method has not been agreed upon), trihalomethanes (outside lab), haloacetic acids, pesticides, total organic carbon, heavy metals such as mercury, tin, and barium.

Equipping the laboratory to conduct full microscopic analysis may seem redundant with the RSS and WAJ labs but it may be desirable, although not necessarily from a public health perspective, to have full microscopic capability It would serve as a general quality control since most microscope testing is very subjective

The MOH lab has most of the capability to test water for those parameters that insure potability and safety We do recognize that the WAJ and RSS labs also have similar capability but, but since the Ministry of Health is responsible for the ultimate decision for the acceptability of the drinking water in Amman having a lab that would provide routine monitoring for these parameters would insure a rapid and decisive response if another event occurred, particularly a microbiological incident It would also provide a quality control check on other analytical work being conducted in Amman The present laboratory has the basic foundation for reinforcing its analytical capacity in a way that builds on the excellent staff and basic knowledge that already exists In addition since, the lab has only one AA and one GC this may be the time to add needed duplicate and upgraded equipment

4 0 Equipment Needs

In order to conduct the analysis of the tests listed in the recommended goals listed above the following additional equipment will be needed. glassware, reagents, a second gas chrotomatograph/mass spectrophotometer; a second atomic absorption analyser, a membrane filter apparatus with vacuum pump, and a new microscope along with counting cells and apparatus to filter or concentrate samples

5 0 Space Needs

The present space is adequate to perform the tests presently being conducted. However, if the work load of the laboratory increases or if additional equipment is purchased, the space will not be adequate and would likely have to be increased by approximately 25-50% We recognize that this is a potential problem since available space in the existing building is limited. By reorienting the existing space and by using, perhaps, office space on another floor sufficient area may be obtained without having to expand into another building Since not all the testing would be ongoing simultaneously there should be adequate room for the analysts

6 0 Training Needs

As we have already noted, any laboratory should provide periodic upgrade training for the chemists, microbiologists and assistants This can be provided by supervisory staff or by outside professionals If the replacement equipment is purchased as outlined here, the training can be provided by the manufacturer On the other hand, a comprehensive upgrade/equipment training program may be desirable to review some of the techniques recently developed in the industry

7 0 Recommendations

The following recommendations are submitted for your consideration However, the present laboratory operation is well managed, has good QA/QC procedures, have complete reporting

forms and with minor training and, perhaps some minimum space reorientation the laboratory would meet standard laboratory acceptability

- Consider adding to the present laboratory equipment including a new AA, new GC, MF apparatus, and microscope
- Increase the space by approximately 25-50% to accommodate the new equipment
- Provide a small on-site library for reference by the staff during analysis
- Add additional safety equipment
- Provide additional training for the staff that refreshes analytical techniques

8 0 Implementation

Implementation of these recommendations suggests that the Ministry of Health proceed with the following program.

1 Conduct a detailed lab audit which delineates procedures, MDLs, records, equipment, etc

2 Determine which, if any, equipment needs replacement and any additional glassware needs

3 Prepare a training manual and program for refresher education

4 Prepare purchase specifications of equipment

5 Prepare layout plans for a redesigned laboratory with the existing space

6 Prepare construction documents

ANNEX A Estimated Costs of Improvements to Ministry of Health Main Laboratory

The following cost estimate is based on the recommendations outlined in our report They include equipment, glassware, reagents, cabinets, reconstruction of the existing lab space, and training

Item	Description	Cost in US$
1	Purchase a new gas chromatograph including glassware and supporting equipment	130,000
2	Purchase a new Atomic Absorption unit including graphite furnace, sample preparation equipment, and glassware	120,000
3	Purchase equipment needed to perform membrane filter biological tests including funnels, vacuum pump, burners, supply of filters, Quebec Colony Counter, new incubator, and all associated and support equipment	17,000
4	Purchase a new microscope, Sedgewick-Rafter apparatus, whipple cells and all associated equipment	9,000
5	Purchase an analytical reference library for routine use by analysts including books on microscopic analysis, laboratory techniques, chromatography, etc	2,000
6	Upgrade the counters, laptops, air conditioning, safety equipment, and general work space to accommodate the new equipment and testing	75,000
7	Provide two weeks of in-house laboratory refresher training in microbiology standards, new techniques, protocols, safety*	47,000
8	Miscellaneous additional items to be identified during a lab audit	20,000
	TOTAL	420,000

NOTE Estimate does not include a fume hood or expanding the existing space

* The training would include two full on-site weeks of specialized training by a laboratory specialist and one week of periodic training by Prof Steve Medlar P E All training materials would be provided. The training would be conducted in analytical techniques, new lab processes, standards, and QA/QC The cost estimate given above is for the first training session, such sessions should be conducted annually, although subsequent training sessions may be for slightly shorter periods