Meeting report

World Health Organization

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Report

Second Meeting of the WHO/UNICEF JMP Task Force on Monitoring Drinking-water Quality

WHO / UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP)

Contents

Introduction

During November 20 – 22, 2013, a Technical Task Force meeting of the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation was held in Geneva, Switzerland. A group of 18 technical experts, 6 members of the JMP and 5 resource persons from UN agencies were in attendance. A list of meeting participants is included in Annex 2. The Task Force was convened to consider how improved measures of water quality and water system safety could be used to improve water safety in the post-2015 Sustainable Development Goal era.

Background

The WHO/UNICEF Joint Programme for Water Supply and Sanitation (JMP) is the international body charged with accelerating progress toward universal, sustainable access to safe drinking-water and sanitation through a system of global monitoring and reporting. A major task of the JMP has been to monitor progress toward the Millennium Development Goal (MDG) 7 target C: *by 2015, halv*e the proportion of people without access to safe drinking-water and basic sanitation. The target for drinking-water was achieved but important questions remain regarding the quality of these new water sources. Due to technological limitations at the time of the formulation, the MDG target made use of a proxy indicator for water safety, based on the assumption that certain water supply technologies were likely to provide safe water. Recent advances in inexpensive methods for directly measuring water quality in the field mean that future water quality monitoring can rely upon actual measurements rather than technology-based assumptions.

In 2010, the WHO convened the first JMP Technical Task Force Meeting on Monitoring Drinking-water Quality, which reviewed the results of water quality surveys piloted by the JMP and others and provided a set of recommendations that encouraged development of improved indicators in global monitoring. An important result of the first task force was the establishment of a 'ladder' approach to water quality monitoring, with a small group of *critical parameters* that should be prioritized where resources are limited. As national monitoring capacity is increased, countries should strive toward regular testing against national health-based targets in a transparent and verifiable manner. In the intermediary period where national capacity for monitoring is not fully developed, surveys of water quality in the household and from water supply distribution points can be used to provide snapshots of water safety to contribute to global assessments. The JMP Rapid Assessment of Drinking-Water Quality (RADWQ) was one such assessment that attempted to gather representative data from 6 countries using a combination of field test kits and national water quality laboratories. The RADWQ and subsequent pilot studies conducted in tandem with household surveys confirmed that water quality testing can be effectively performed at the national level in most countries and that water sources counted as improved may suffer from frequent contamination.

In light of the success of the advocacy and monitoring effort supporting the MDG targets for water and sanitation, the JMP established working groups to develop potential targets and indicators for the post-2015 Sustainable Development Goals (SDGs). It is anticipated that in addition to extending access to those who still lack access to basic water and sanitation, the SDG targets will address other aspects of the sustainable attainment of this human right, including accessibility, availability, and affordability. The Post-2015 Water Working Group (WWG) has proposed a new set of water targets that address these issues and for the first time would include direct measures of water safety. The measurability of these targets was reviewed in the

November 2012 Measurability Consultation, hosted by UNICEF in New York, and they were presented to the wider international community later that year during a technical consultation at the Hague. The WWG and the JMP has requested additional technical guidance from an expert panel to assess the proposed indicators for water safety in the context of current trends in technology and national capacity, with the overall goal of providing representative data to support global monitoring during the post-2015 SDG era.

Objectives

As originally set forth in the meeting Concept Note, the objectives of this meeting were to:

1. review progress in monitoring of water quality in households surveys, dedicated surveys, and regulatory data; and ask for technical guidance on specific issues which have arisen during such exercises;
2. consider possible additional measures of water safety which could be monitored by the JMP; and
3. recommend next steps towards the integration of a drinking-water quality component into the JMP monitoring activities.

Proceedings

Opening plenary

Mr. Bruce Gordon (WHO) and Dr. Andrew Trevett (UNICEF) opened the meeting by describing both the short-term need for the JMP monitoring framework to incorporate measures of drinking-water safety while also maintaining the flexibility to evolve as more advanced methods become available. The opening continued with a brief introduction by each task force participant and presentations by the session chairs.

Mr. Rolf Luyendijk (UNICEF) provided meeting participants who were not familiar with the JMP process with a brief background on global monitoring of drinking-water and sanitation. He explained that the use of a proxy indicator to group water sources by their technology into categories of *improved* or *unimproved* was necessary due to the lack of globally representative data about water quality and limitations in measurement tools at the time. We now have several reliable, field-ready methods for measuring water quality in a nationally representative manner. An important aspect of the work of the JMP is to put issues on the global agenda by defining and measuring outcomes, as illustrated by the positive outcomes stemming from the inclusion of open defecation in global monitoring.

Dr. Rick Johnston (WHO) introduced the three modalities proposed by the first Water Quality Task Force (see Background section for more information) and explained that as expressed in the Drinking-Water Quality Guidelines, the WHO considers a risk-based management approach to be most effective in ensuring water quality. Therefore, water quality measurements are not an end in themselves but a means of verifying the effectiveness of the management approach. However, obtaining nationally representative water quality data can have a powerful advocacy effect on policy-makers, as demonstrated by the national arsenic exposure estimates made possible through an add-on module to the 2009 MICS survey in Bangladesh.

It was agreed that clear communication around water safety is essential. Countries demand use of the word “safe”, and the sector should have clear definitions and indicators of drinking-water safety. This clarity must extend to water quality testing, in particular the location of water sampling: data resulting from household level testing can have different policy implications than data collected at water delivery points. Both types of information could be useful, but there is a danger that if the two are conflated policies would not be clear.

During plenary discussion several important issues arose that the group decided to keep in mind throughout the proceedings:

- Ethical guidelines are needed for how survey enumerators who perform water quality testing will share data with the specific households or water users they visit.
- The meaning of ‘water safety’ in the post-2015 context must be clearly communicated with political leaders and the public.
- International guidelines and national standards differ for many important indicators and reflect different objectives for reporting.

Future directions in global water quality monitoring

Mr. Tom Slaymaker presented the proposal of the Post-2015 Water Working Group (WWG) and discussed the rationale for the proposed targets and indicators. The targets reflect an increased emphasis on the concept of different levels of service and calls for expansion of the scope of global monitoring to include settings outside of the household: schools and healthcare facilities. The proposal currently envisions two levels of service, with a basic level based on the MDG-era *improved* technology definitions combined with a measure of accessibility to the source. A more aspirational, intermediate level of service includes the following criteria:

- **Availability** - not more than 2 days of discontinuity in 2 weeks
- **Accessibility** – improved water source located on plot or in the home
- **Quality** – *E. coli* levels less than 10 CFU / 100 mL year-round at the water source

How safe are improved water sources

Mr. Slaymaker continued with a presentation of the early results from a review of the data on the microbial quality of improved water sources. The study was conducted by the Water Institute of the University of North Carolina at Chapel Hill and will be submitted to an open-access academic journal to ensure that the results are widely available. The methodology included meta-analysis, an approach that allows the results of multiple studies to be pooled together, of over 318 separate studies. The meta-analysis of comparisons between different water sources performed within studies found an odds ratio of 0.23 for improved versus unimproved sources, meaning that water from an improved source is approximately 4 times less likely to contain the faecal indicator bacteria *E. coli* than water from an unimproved source.

The question of whether certain water supply technologies are more likely to become contaminated in certain settings was also addressed, through meta-regression analysis. Rural water sources were twice as likely to be contaminated as urban sources, and meta-regression analysis showed that for piped water supplies, rural schemes were significantly more likely to be faecally contaminated than urban schemes. However, there was no significant difference between water quality in urban and rural settings for other improved sources (boreholes, protected dugwells, protected springs, and rainwater harvesting). Overall it was noted that all

improved water sources suffer from high levels of faecal contamination in some cases and that significant variability exists both within and between studies.

The discussion within the Task Force focused on the implications of the study, the potential sources of bias and the question of how sanitary inspection scores relate to water quality. One important source of potential bias is that studies of water quality tend to be performed in areas known to suffer from water quality problems. A small number of comprehensive studies such as the JMP Rapid Analysis of Drinking-Water Quality (RADWQ) have generated statistically representative data that provide a reliable snapshot of water safety across entire countries; more such studies are needed, and care should be taken to design surveys to minimize biases.

Plenary discussion on specific questions

On each of the first two days of the meeting, findings and recommendations were determined through consensus after a plenary discussion in which questions from the meeting Concept Note. The first plenary discussion on questions AA through FF was moderated by Mr. Rolf Luyendijk (UNICEF). The summary of the discussion and related findings are presented in the following section, Findings.

Water quality management

Mr. Bruce Gordon began Day 2 of the Task Force meeting with a brief presentation on introducing water quality management and regulation data into JMP monitoring efforts. The sources of such data may include household surveys such as DHS and MICS, publicly available regulatory reporting data available directly from governments or through RegNet, data from water service providers collected by organizations such as IBNet and dedicated national water quality surveys to include RADWQ and second-generation RADWQ surveys. Some of these data will require adjustment or supplementation to address gaps that are often found outside of large urban centers or for underserved populations such as informal settlements or conflict zones. Outside resources for monitoring could be concentrated on addressing these gaps once they are known to ensure that unmonitored populations are represented. Mr. Gordon closed by referring to an approach recently outlined by Dr. Bartram, which calls for a four step process for monitoring of water quality management:

(i) *Collect* suitable data from water quality surveys, sanitary inspection and water safety plans;

(ii) *Stratify* the data by settlement size and technology type;

(iii) *Adjust* for the frequency of sampling and seasonality; and

(iv) *Combine* the adjusted data to obtain national estimates.

Possible indicators: working with regulated water supplies

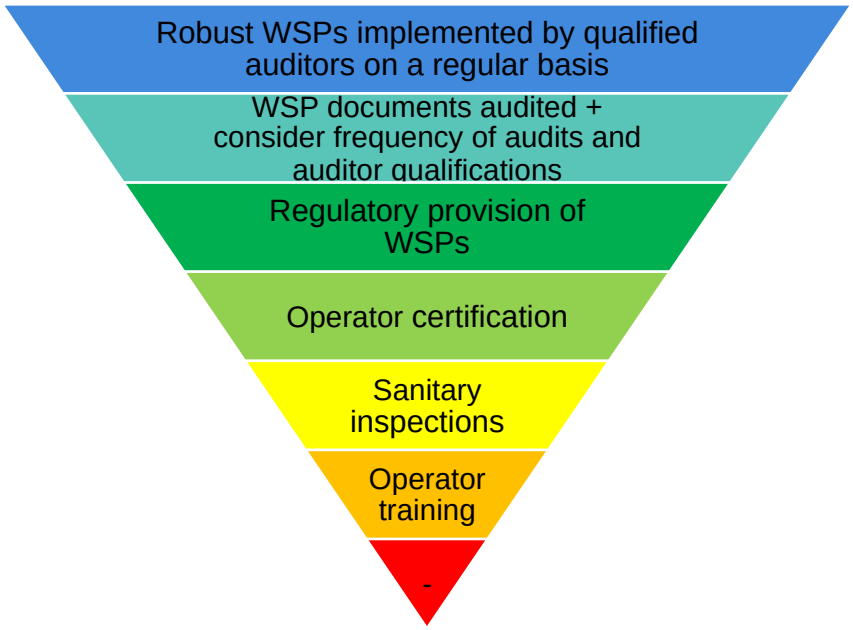
Ms. Jennifer de France (WHO) presented preliminary results from the WHO/AusAID Water Quality Partnership, which has developed over 150 Water Safety Plans (WSPs) and assessed the implementation of 22 WSPs through site visits to participating countries. The recent WHO/IWA Auditing Meeting (April 2013) identified several lessons relevant to global monitoring of water system management:

(i) WSP is a continuous improvement process and the complexity of the management system should be expected to increase over time;

(ii) desk reviews of WSPs should be complemented by on-site assessments to assess the quality of implementation; and

(iii) auditors need to be sufficiently qualified through a combination of certification and practical experience.

One example of a certification program that is used in Portugal is the ISO 22000 standard for Food Safety Management[1]. Ms. de France also directly addressed the issue under consideration by the Task Force in Questions GG and KK regarding how water management data could be used in global indicators for water system management. Within the context of the WSP process, WHO experience has shown that a ladder approach similar to that used by JMP for water supply technology could be created based on increasing levels of WSP verification and implementation. In regions that do not adhere to the WSP approach, Ms. de France also identified some potential indicators for water system management that are typically measured by utilities or regulators. This combined WSP and regulatory data approach is summarized in the figure below.



Presentations from water regulators

The Task Force was fortunate to benefit from a diverse range of perspectives from water regulators to help frame the discussion around indicators for water system management. The presentations covering the Blue Drop Certification Program in South Africa and the Impact reporting system recently implemented in Kenya underscore the potential for transparency and public accountability to motivate both local and national action to improve water service provision. The Portuguese experience in bringing compliance rates from 50% to 98% within 20

years demonstrates the rapid progress that is possible with a well-organized national regulatory approach based on a clear strategy and identification of institutional responsibilities. Finally, the progress in Uganda made toward WSP implementation and regular water quality monitoring in the absence of an independent regulatory body help to define the type of management data that might be obtained directly from service providers.

Water quality monitoring: a regulator's perspective, Richard Cheruiyot, Water Services Regulatory Board (Wasreb), Republic of Kenya

In Kenya, only 16% of the rural population is currently served by a formal water service provider, but the new 2010 Constitution has introduced important reforms such as the devolution of power from the national to county government level and the endorsement of a universal human right to water and sanitation. The Water Services Regulatory Board (Wasreb) is working to first develop an inventory of Small Scale Service Providers (SSSPs) and then bring them under the regulatory authority of the local licensed utility. The license includes requirements for the securing of water sources (similar to the Water Safety Planning process) and monthly reporting of water quality test results. The Water Quality Monitoring Guideline specifies parameters to be measured against the Kenyan national standards and sampling is required from source to tap. Whenever feasible, thermotolerant coliform (TTC) or *E. coli* is monitored in piped systems but when this is not possible, chlorine residual is also used to assess compliance. Water system performance is assessed based on the proportion of samples that comply with standards as follows: Good = 96% compliant, Acceptable = 90 – 95% compliant and Not Acceptable = less than 90% compliant. Both the percentage of compliance and the total number of samples are reported in the annual *Impact* report[2], which is made publicly available on the Wasreb website.

The timely public release of the *Impact* reports has been effective in improving utility performance since each utility must perform public consultations before submitting tariffs for approval. In response to questions regarding the enforcement powers of the regulator, Mr. Cheruiyot noted that while penalties for non-compliance are enforced, some providers elect to simply continue paying the penalty rather than make improvements. A new system of escalating sanctions that eventually can result in revoking the Service Provision Agreement (SPA) has been effective; however, for large utilities revoking the SPA is not practical so stiffer penalties are being introduced in those cases. With regard to the smaller service providers, the goal of Wasreb is to bring any provider serving more than 20 people under regulation. Wasreb has the authority to perform oversight of local monitoring and is considering a system including part-time inspectors in some areas to make the most efficient use of resources. The remaining challenges for Wasreb include developing local capacity to undertake water quality monitoring (both infrastructure and human resources), increasing the number of parameters that can be monitored and the lack of inclusion of water monitoring in the tariff structure of many service providers.

The Regulation of Drinking-water Quality in South Africa - Blue Drop Certification, Helgard Muller, Water Policy and Regulation Consultant in the Republic of South Africa

Mr. Helgard Muller, recently retired from the Department of Water Affairs of the Republic of South Africa, described the origins and philosophy behind the unique and widely recognized regulatory approach known as the Blue Drop Certification Program. South Africa was one of the earliest countries to recognize a human right to water, which was established initially in the 1996 Constitution and further clarified through relevant water legislation and regulations as well

as court challenges to ensure a minimum standard for a basic water supply of 25 liters per person per day of water within 200 meters of the household, with interruptions no longer than 7 days in any year. Adequate service provision proved challenging in the face of rapid urbanization throughout the country and regulators reached the conclusion that punitive measures would not achieve the desired actualization of the right to water. In response, the innovative Blue Drop Certification program was developed, which uses an incentive-based approach toward regulation. An evaluation framework was developed that incorporates legal requirements, international best practices in water system management and effective asset management. Since the system began in 2009, four annual reporting cycles have been completed and the number of Blue Drop Certificates (which denote excellent as opposed to merely adequate performance) have increased from 25 to 98, while the average score increased from 51% to 87%. One example of the impact of public pressure on utility performance in the face of such transparency is in Victor Khanye LM, where a serious diarrhea outbreak occurred in 2009, when the Blue Drop score was only 20%. By 2012, the score had increased to 80% and the provider won the national award for most improved score.

In conclusion, Mr. Muller notes that internationally accredited, publicly available regulatory results can be very effective in motivating utilities to improve service provision. In response to questions from the Task Force, Mr. Muller reiterated that no direct monetary rewards are connected with achieving Blue Drop certification. The entire program is based on public posting of certification results and makes use of award ceremonies and media attention to generate demand for higher-level services. Some of the remaining challenges for regulation in South Africa include the growing demand from the middle class for service levels above the basic level required by the Constitution and the potential for smaller providers to invest in unnecessarily complex and expensive infrastructure in order to achieve higher scores in the corresponding wastewater management program, the Green Drop Certification program.

Regulating Drinking-water Quality in Portugal, Luís Simas, ERSAR, Portugal

Mr. Simas introduced the system of regulatory reforms that allowed Portugal to increase the number of people with access to safe water from 50% to 98% within 20 years using a sophisticated real-time national monitoring system. The key elements which made this achievement possible included a strong political commitment in response to public awareness of poor water sector performance, progressive implementation following well-defined priorities and a comprehensive, holistic approach. The key steps in this holistic approach were to define a clear strategy for the entire water sector, clarify institutional responsibilities, create a regulatory model and implement a legal framework to support this model. In contrast to the constitutionally-driven legal reforms in South Africa and Kenya, Portugal defined a new regulatory model based on transparency, international accreditation and data reliability and backed this up with a central regulator that receives all data on non-compliances within 24 hours and has the authority to perform random inspections and issue penalties. Portugal also invested in technology to provide real-time views of system performance, allowing regulators to quickly identify the most problematic service providers.

Task Force participants were interested in the costs associated with the Portuguese approach and how responsibility was distributed among the regulator, utility and municipality. Mr. Simas responded that the primary challenge in implementing the regulatory program was not cost, but rather organizing the sector and identifying the right human resources for the job. The water sector in Portugal includes a mixture of public utilities, private providers and concessions, but

ultimately responsibility for problems rests directly with the provider unless they are able to demonstrate that the problem is caused outside of their system. In accordance with European Union policies, utilities are responsible for water quality all the way to the tap unless it can be shown that contamination occurs after the water meter. Reporting of water quality is similar to the Kenyan and South African models, where the primary indicator is the percentage of samples that are in compliance with national standards. Portugal uses a traffic light system to monitor compliance: Green = 99%, Yellow = 95 – 99 % and Red = < 95%.

Water Service Provider's Perspective, Susan Namaalwa, Quality Manager, National Water and Sewerage Corporation, Republic of Uganda

Ms. Namaalwa was kind enough to provide an impromptu presentation about the experience of the National Water and Sewerage Corporation of Uganda in improving water quality in the absence of a central regulatory body. In Uganda, water service providers operate as government mandated utilities and must be self-sustaining through tariffs. Towns have their own laboratories that perform water quality analyses and they are subject to oversight by the Central Water Quality Management Office in Kampala. Performance contracts are signed with the Government of Uganda for 5-year periods but until recently the performance targets have focused on pricing and coverage. However, environmental and water quality standards were recently added to a contract for the first time and the implementation of Water Safety Plans has increased the monitoring of smaller supplies. The possible establishment of an independent regulator has been a subject of intense discussion in Uganda, but doubts exist regarding whether the capacity currently exists for creating an effective regulator and whether citizens would perceive an added value from this approach.

Second plenary discussion on specific questions

Dr. Mark Sobsey (University of North Carolina at Chapel Hill) chaired the second plenary discussion during the afternoon of Day 2. The results of this discussion are presented in the Findings section below. It should be noted that the order of the specific questions was changed and this new ordering is reflected in the Findings section.

Findings

The Findings of the Task Force are grouped below by the questions in the order in which they were discussed. Some questions had multiple parts and these are addressed separately when appropriate in boxes below each heading. Findings are intended to convey the consensus view of the Task Force in response to particular questions that were posed, whereas Recommendations are the work going forward needed to address the implications of the Findings as they relate to the work of the JMP. These are identified by the word **Finding** in boldface type followed by a number and a complete list is found in Annex 1.

Question AA: Reporting Microbial Water Quality

AA-1: In different countries and settings, microbial data will be collected and reported with different methods, detection limits and reporting levels. JMP proposes to report data in terms of "Risk Classes" ranging from A (<1 CFU/100 mL) to E (>1000 CFU/100 mL), and to aggregate E. coli with TTC, and possibly other faecal indicator bacteria. Does the TF endorse this decadic classification system?

The decadic (or decimal) risk classification was found to be useful in water systems that are infrequently sampled and is consistent with the example risk assessment prioritization approach recommended in Table 5-4 of the WHO Drinking-Water Quality Guidelines. However, it was noted that these categories tend to be over-interpreted and the index was intended to be used only for individual water supplies, in combination with an assessment of water system risk, such as a sanitary inspection.

The upper limit of the risk classification scheme was discussed, with most participants feeling that classes D (101-1000 CFU/100 mL) and E (>1000 CFU/100 mL) should be merged. Dr Metcalf felt that the E class was important to retain, and noted that Médecins sans Frontières (MSF) makes a distinction between the two.

The JMP should develop guidance on how many data points would be needed within a classification for reporting purposes. Expert advice should be sought from statistically minded microbiologists to support these recommendations.

> **Finding 1.** The classification system using 4 categories (less than 1, 1 – 10, 11 – 100, and greater than 100 CFU per 100 mL) presented in Table 5-4 of the WHO Drinking-Water Quality Guidelines should continue to be used when presenting water quality results, but should be interpreted in conjunction with an indicator of water system risk. The majority of participants agreed that there is no need to separately report higher levels of contamination (i.e. > 1,000 CFU per 100 mL). All results should be reported in terms of 100 mL volumes, even if the actual test volume is different.

AA-2: Would the TF endorse aggregating different types of measures? (e.g. MPN and MF; *E. coli* and Thermotolerant Coliforms; *E. coli* and Enterococci; *E. coli* and H_2S).

The use of indicators for identifying faecal contamination of water supplies is an area of active scientific research and numerous alternative indicators have been proposed. Although some of these alternatives, such as Enterococci or *Clostridium perfingens*, may have some advantages over *E. coli* in terms of their survival rates in the environment or resistance to disinfection, the Task Force endorses the continued use of *E. coli* for global reporting. In some situations it may be necessary to use data from countries where less specific faecal indictor detection methods, including thermal tolerant coliform (TTC) or faecal streptococci, but countries should be encouraged to begin reporting *E. coli* levels whenever feasible. Dr Metcalf stressed that countries should strongly be encouraged to replace the TTC test with an enzymatic *E. coli* test.

> **Finding 2.** *E. coli* should be the preferred index of faecal contamination used in global monitoring. Where JMP directly supports water quality testing, *E. coli* should be the indicator used. If data on thermotolerant coliform or Enterococci are available, the JMP could use these, aggregated with *E. coli* data, for global monitoring purposes. However, data on total coliforms, or the hydrogen sulphide assay, should not be collected and aggregated for these purposes.

Question BB: Definition of sampling points

BB: JMP proposes a set of terms and definitions to be used consistently in reporting (e.g. point of collection, point of use) for the TF to comment on, revise, and possibly endorse.

The Task Force supports the notion of a framework to provide data providers with a standard set of definitions for sampling points and how the definition might apply in different water supply schemes. This guidance could take the form of a short interface document or a spreadsheet that identifies where the data provided to JMP were sampled. The scope of such a tool should be to serve as an interface between national regulatory system data and international monitoring efforts, rather than to provide guidance on how to perform monitoring or identify risks.

The current focus of sampling drinking-water at the point of consumption and at the source is appropriate and valuable, since these sampling points relate to the two key policy questions:

- Are people drinking safe water?
- Is safe water made available?

It is likely that politicians and public health agencies will be more concerned with the outcome, i.e. the water people actually drink, whereas regulators and utilities must confine their focus to the water they provide to the household. Some regulators are happy to sample water at a household tap; others prefer sampling points outside the house to represent a delivery point, e.g. before the water meter. By addressing water quality at both the point of consumption and the point of delivery, the JMP can simultaneously advocate for the actualization of the human right to water and also encourage the development of effective regulatory oversight and water system management.

JMP should be consistently and explicitly clear about whether its data refer to points of consumption or delivery. An example formulation could be: “70% of the population are consuming safe drinking-water. Of the 30% drinking unsafe water, one third have unsafe water at the point of delivery.”

Finding 3. Global monitoring of drinking-water safety should focus on both the point of consumption and the point of delivery.

Question CC: Improved versus Unimproved Classifications

CC-1: Should the improved/unimproved classifications be retained at all, in the case where at least some Water Quality or Management information are available? JMP proposes to do so, but to apply correction factors by technology to account for water quality shortcomings. Does the TF endorse this approach?

The clarity of the improved/unimproved approach was effective during the MDG era in motivating policymakers to improve access to drinking-water. The findings of the meta-analysis presented at the meeting support these classifications, finding that water from an improved source is significantly less likely to contain faecal contamination than water from an unimproved

source. Based on this evidence and the need to maintain continuity between pre-2015 and post-2015 datasets, the Task Force supports the continued use of these definitions, even though the main focus of reporting may shift to new post-2015 classifications (e.g. Basic and Intermediate drinking-water). It is also important to note that the meta-analysis found such high variability in the contamination rates of different systems even within single countries that it would be difficult to justify the use of correction factors without significant new sources of nationally representative data.

Finding 4. The current JMP system for classifying water systems as improved or unimproved based on the technology used should be retained in post-2015 monitoring because of the importance of continuity with previous JMP data and based on the available evidence, which indicates that improved sources are less likely to suffer from faecal contamination.

Finding 5. The use of correction factors to indicator attainment based on data from water quality surveys may be possible on a country-by-country basis, with appropriate caveats given regarding the variability of water quality data for the technology.

CC-2: Should JMP measure water quality on unimproved sources as well?

The evidence from the meta-analysis supports the view that water from an unprotected source is much more likely to be microbiologically contaminated. Since unimproved sources do not incorporate measures to prevent contamination, the Task Force does not recommend that JMP expend its limited resources on monitoring the water quality of these sources. Likewise, negative water quality test results from unimproved sources should not be interpreted to mean that these sources are safe because the technology used to construct them does not accommodate the risk management approach needed to safeguard water quality at all times. However, water sector workers at national or sub-national levels may well measure water quality in conventional unimproved sources, in order to inform local communities where contamination is found.

Finding 6. The JMP should not include water quality data on unimproved sources in global monitoring.

Question DD: Basic Access

DD-1: Does the Task Force endorse the definition of Basic Access proposed by the WWG? Specifically, does the TF endorse the suggested revision to Improved/Unimproved technologies, to be different in urban and rural settings?

The WWG proposes to exclude certain technologies from the definition of *improved* water based on whether the source is located in an urban area. The Task Force expressed concerns both about the evidence for this approach and the implications it might have on existing

programs. The Water Institute meta-regression did not show significant differences between urban and rural areas for water sources using a particular technology, except for piped water which was worse in rural areas. While it was noted that the uncertainty associated with the analysis was large and might obscure small differences, at the present time the data do not support revision of the current definitions.

Finding 7. There is insufficient evidence to exclude certain technologies from the definition of an *improved* water source based on whether it is located in an urban or rural area.

DD-2: Should dug wells continue to be considered *improved* sources, considering technical as well as political dimensions?

The meta-analysis concluded that a clear hierarchy exists within the different types of improved water sources, with piped and borehole systems much less likely to be contaminated than rainwater harvesting, protected springs and protected dug wells. However, these differences were not as great as those between an aggregated comparison of improved sources and unimproved sources. Thus, the drinking-water ladder approach—with piped water at the highest level—is supported by the study but there is insufficient justification to make modifications to the *improved/unimproved* classifications. It was further noted that excluding dug wells (or rainwater harvesting) from the 'improved' classification would have a negative effect on properly installed and monitored supplies if they are shown through testing and proper management to provide safe water (i.e. 'Intermediate Access').

Finding 8. Although piped and borehole water is clearly less likely to be contaminated than other improved water sources, there is insufficient evidence to reclassify particular improved sources as unimproved.

Question EE: Intermediate Access

EE: Does the TF endorse the definition of Intermediate Access proposed by the WWG? Specifically, does the TF endorse the suggested indicator of <10 CFU E. coli/100 mL?

Task Force members expressed concerns with the proposed indicator threshold value of 10 Colony-Forming Units (CFU) per 100 mL for the intermediate service level. Although such a target would be easier to measure in low-resource settings and easier to attain for many water systems, this approach is inconsistent with WHO guidelines and most national government standards, which specify that faecal indicator bacteria should not be present in a 100 mL volume. An intermediate standard implies that some level of faecal contamination should be tolerated but this is not consistent with the risk management approach advocated by the WHO. Professor Metcalf was not among the majority of task force members who opposed the intermediate target of <10 *E. coli*/100ml, on the basis that he considered that if JMP restricts itself to 100 mL tests, there will be few data points from developing countries.

It was noted that the current WWG proposal lacks an aspirational high level of service with a corresponding higher target for water quality. Considering that the emphasis of post-2015 monitoring will be on access to safe water, setting an intermediate standard that is lower than

most well regulated water systems could undermine the message JMP is providing to the international community.

The Task Force discussed at length alternatives to the WWG proposal, and this issue was brought up again on the final day of the meeting. There was broad agreement that any proposed targets involving thresholds for water quality should also include some measure of water system management, as set forth in the Water Safety Planning process or a similar health-based risk management approach. The monitoring approach should encourage multiple samples to increase the statistical validity of the results and support verification of the risk management approach developed for the water system. Finally, any microbiological water quality targets employing indicators of faecal contamination should reflect the principle that no level of faecal contamination should be considered safe.

> **Finding 9.** The establishment of an intermediate target of 10 CFU / 100 mL for faecal indicator bacteria in drinking-water is not recommended because it does not incorporate a measure of water system management, places undo emphasis on a one-time measurement and is not consistent with the WHO and other international guidelines, which indicate that no level of faecal contamination is acceptable. This standard should not be taken as a measure of 'water safety'. If a microbial standard were to be retained for an Intermediate classification, <1 CFU/100 mL would be more appropriate. However, an even better approach would be to set a target that includes both microbial quality and measures of risk management.

Question FF: Chemical Water Quality

FF: Arsenic and fluoride are not mentioned in WWG proposed text. Does the TF recommend that such parameters be included in a 'must have' tier of parameters? How should results be tracked when country standards differ?

The Task Force expressed strong support for the inclusion of arsenic and fluoride in the minimum set of parameters included in global monitoring due to the significant global health impacts that they continue to cause. The setting of national standards for chemical contaminant exposure is a complex issue involving cultural perceptions of acceptable risk, effectiveness of regulatory institutions and practical considerations such as the capacity to perform measurements and mitigate exposure. The JMP should adhere to WHO guidelines whenever possible but where national standards differ, the Task Force encourages reporting of the indicator against both the national standard and the WHO standard.

> **Finding 10.** Arsenic and fluoride should be included in the top tier of parameters for global drinking-water monitoring and sampling should be encouraged unless there is clear evidence of a lack of geological susceptibility, an absence of exposure symptoms in the population and prior representative sampling that did not detect these contaminants. Reporting of compliance should primarily reflect national standards, but could also reflect on global norms (e.g. WHO Guidelines).

Question II: The future of global monitoring

II: Taking the long view: by 2030, how will global monitoring look? What will be the mix of

information from household surveys, regulators, institutions, and other sources?

Task Force participants began the afternoon session with a long and far-reaching discussion of the future of global water monitoring in the post-2015 era. As reflected in the findings of the Task Force, the JMP will need to integrate new streams of data from national representative water quality surveys, indicators of water system risk and proper management and regulatory networks. Ubiquitous use of information and communications technology will mean that more real-time data will be available and can harnessed to reduce the time required to report on access to water and sanitation. The same technologies can help ensure that information is available to the public, leading to increased transparency and accountability for service providers.

In addressing the timeframe given in Question II, it was noted that this 15-year horizon resembles an extension of current trends, whereas the original SDG timeframe of 25 years will see much more revolutionary changes. Changes in the distribution of populations and wealth increasingly blur the present distinctions between developed and developing nations while climate change increases pressure on water resources in many regions. Significant improvements in the technologies used to monitor and treat water can be expected during this time period, which may bring much better levels of service to people who now only have access to basic services. However, as the importance of technology in providing safe water increases, inequity may increase in many societies if the price of safe water becomes increasingly out of reach for the poor and disadvantaged. Therefore, the role of the JMP to shine a light on inequity in access to safe water and sanitation will become increasingly important in the post-2015 context.

Question GG: Combining water quality and management information

GG: How can WQ measurements and WQM information be used in combination? Can the risk matrix (sanitary inspection vs. *E. coli* results) be standardized or extended to include broader management indicators?

Discussion within the Task Force concentrated on how water quality and management information might be combined into a meaningful, and measurable indicator that is simple enough to be used for advocacy but specific enough to identify specific areas in need of improvement. While measurability is critical, indicators should also be flexible so as not to force a single approach such as sanitary inspections of all sources when this is not feasible. A challenge for measurability will be to integrate data from different sources, e.g. household surveys and national regulatory monitoring tools. The discussion of water quality indicators was linked to Question EE regarding the WWG *E. coli* target, with the Task Force reiterating the view that a single sample for faecal bacteria should not be the basis for establishing the safety status of a water source. A consensus emerged around the risk matrix approach that has already been implemented effectively in Water Safety Plans and other industries such as food production. In the context of water systems, the matrix would include some measure of water quality compliance on the vertical axis and a measure of water system management on the horizontal axis. Water systems that score poorly on one or both of these measures are considered to be at

the highest risk for adverse health impacts. Moderate scores on both measures are considered intermediate risk and those with high scores for both indices are the lowest risk systems.

The remaining issue is how to report the attainment of the combined water quality and water system management indicators at the national and global level. To effectively implement a risk matrix approach, the JMP will need to develop a framework for interpreting a more complex mixture of data coming from regulators, utilities and household surveys. The specific measures of water quality management that might be used are considered in the next section on Question KK. The two indicators are not independent of each other since improved water system management should require more frequent water quality sampling to verify compliance, and if the management system is effective then compliance rates should increase. Therefore, the Task Force recommends that minimum thresholds be set for each of these two component indicators that make up the combined risk. This will simplify reporting, which can then focus on determining the number of persons in each country or disaggregated group that meet the minimum thresholds.

Whether thresholds corresponding to basic, intermediate and high service levels should be created was a subject of debate throughout the Task Force meeting. Some participants felt that intermediate targets are likely to be dropped during the SDG consultation process, since policy makers are most interested in the simple question, "how many of our citizens have safe water." Others believed that the JMP should begin the work of educating policy makers to understand a more nuanced view, which is also consistent with the concept of progressive realization, bringing higher levels of service to all segments of the population. The future work needed to further develop these thresholds is captured in the Task Force recommendations.

> **Finding 11.** A risk matrix approach, combining an indicator of water quality and an indicator of water system management, should be used in global monitoring of safe water and should be extended to accommodate typologies for both point sources and distributed water networks.

Question KK: Measures of water quality management

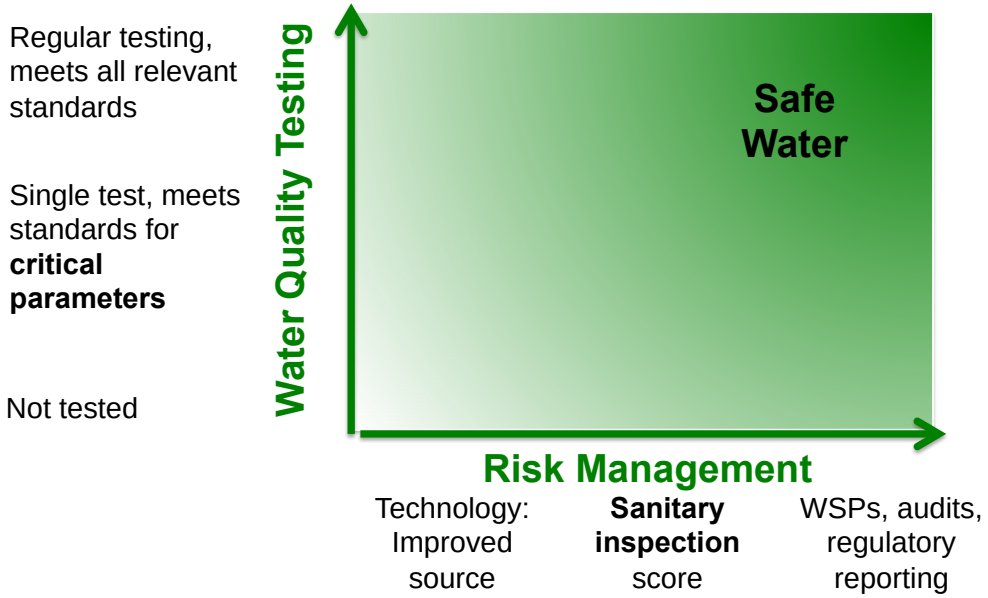
KK: In the short term: what does the TF recommend that the JMP do vis-à-vis incorporation of water quality management measures into global monitoring?

The effort to develop indicators for water quality management will be critical to the global monitoring of safe water under the SDG era and the Task Force recommends that work begin immediately on a framework to obtain and interpret data on water management. The presentations from regulators were helpful in framing the sort of processes used to monitor water system management and the potential data that might be available. A 'traffic light' system similar to that used by several regulators, may be an effective way to report data in a manner that could be easily understood by the public.

Furthermore, the WSP assessments performed by WHO have provided a progressive scale to measure increasing regulatory effectiveness. Both regulators and service providers have shown a willingness to provide data, but it is important that the JMP clearly defines the requested data and avoid burdening the regulators by repeated requests for additional information. To this end, the Task Force proposes a work package, detailed in the Recommendations section, that creates

a conceptual framework for assessing water quality management data and proceeds to engage with a small number of countries to refine the proposed indicators and data requirements.

The incorporation of measures of water system management into a new indicator for water safety should follow a risk matrix approach endorsed by the Task Force in response to Question GG. The development of the indicator could begin with a mapping of existing data available from regulators and identifying how gaps could be addressed using household surveys and new RADWQ efforts to monitor water sources in a representative manner. The most basic questions that could be asked pertain to how many systems are under some sort of management or regulatory system, and what proportion of the population these serve (this is in fact one of the indicators of 'sustainability' proposed by the WWG). By approaching a small number of countries with a diverse set of management practices, the JMP could begin to develop thresholds for the assessing the quality of water system management. The progressive nature of the risk management approach is illustrated in the figure below, where 'safe water' is associated with increasing levels of risk reduction through water system management and verification through water quality testing.



Question HH: Household water treatment and storage

HH: HWTS can be considered as a form of water quality management, at the most local level. JMP currently collects information on self-reported HWTS practice through household surveys, though these have been criticized as representing over-estimates. Should JMP factor in reported HWTS into any integrated measure of water safety?

Many Task Force members expressed support for Household Water Treatment and Storage (HWTS) as a policy approach to dealing with contaminated water sources but serious concerns exist over whether compliance with treatment can be accurately measured. Evidence from

studies where the self-reported usage of HWTS was independently assessed by water quality tests indicate that household surveys of HWTS are likely to significantly overestimate compliance. Since a major theme of the post-2015 water agenda is to move away from conflating access with safety, better approaches are needed to measure the actual use of HWTS before it can be recommended for inclusion in global monitoring. It was noted that household surveys such as MICS currently ask about HWTS and if these questions are removed, it will prove difficult to add them back in later when improved methods become available. The Task Force recommends that this issue be revisited by the WHO Drinking-Water Committee.

> **Finding 12.** Household Water Treatment and Storage (HWTS) is not recommended for inclusion by JMP as a form of water quality management at the present time due to the challenges associated with obtaining accurate estimates of usage but should continue to be assessed as new measurement approaches become available.

Question JJ: Capacity development

JJ: How should monitoring for regional and global purposes link with capacity development at the national and subnational scale?

The most important role for JMP in capacity development is to provide clear guidance on the parameters and data quality needed for water quality data for inclusion in global estimates. The Task Force recommendation to develop a framework for assessing water management data also supports the notion of capacity building by encouraging more effective regulatory approaches. The JMP should continue supporting the development of methods for water quality monitoring during household surveys but does not need to advocate for particular test methods or technologies. By specifying a preferred set of parameters and standards for evidence of compliance, JMP will encourage local ownership of data and foster innovative approaches that meet each country's unique demands and resource constraints.

Conclusion

In the three-year time period since the first Task Force Meeting on Monitoring Drinking-water Quality, significant developments have occurred in defining the Post-2015 water agenda. This process resulted in a number of critical questions that need to be addressed in order to develop a credible approach to measuring the fulfillment of the human right to safe drinking-water at the global level. During the 3-day meeting of the Second Task Force, these questions were considered by a panel of experts in water quality, statistics and monitoring and water regulatory management. Very specific guidance in response to these questions has been provided in the Findings section. The report concludes with recommendations that either require additional work beyond the scope of the three-day Task Force Meeting or require the involvement of outside groups such as the Post-2015 Water Working Group or WHO committees. The Task Force concluded by reviewing the recommendations listed below and charging the JMP with a call to begin work on these critical monitoring issues soon so that solutions will be ready by 2015. The Task Force strongly endorsed the previous work of the JMP in elevating the status of water and sanitation to the highest levels of the global development agenda, which has directly resulted in significant improvements to health and wellbeing around the globe.

Recommendations

1. In the **near-term**, the Task Force recommends that the JMP should continue to draw upon household survey and national census data, and scale up the piloting of direct water quality testing within these instruments. The issues that should be addressed within this context include:
    a. Ethical guidance on reporting back the results of water quality surveys to households and the national water sector.

    b. Provide a clear communications package on what faecal indicators such as *E. coli* represent and how they relate to pathogen exposure and health impacts.

    c. Refer to WHO guidelines regarding the suitability of rapid tests and methodologies for water quality parameters

    d. Whenever feasible, testing of water quality at the point of consumption (i.e. household) and the point of delivery (i.e. source) should be encouraged.

    e. The JMP should develop criteria for accepting country-level water quality data for inclusion in global monitoring purposes. A related initiative should be the development of guidelines for water quality survey design, for those planning water quality surveys that could potentially be included by JMP for global monitoring. There will be substantial overlap between these two guidance documents, but there is value in having separate documents as the specific purposes are different.

2. The Task Force recommends that the JMP rapidly develop a package of work to establish a framework for integrating data from national water quality regulators. This would be developed in parallel to traditional data collection through surveys, but would not be operational until the post 2015 period. The JMP should consider whether preliminary results from this effort could be communicated in a public forum such as the 2014 IWA Congress. The work package should include:

    a. Mapping of publically available data.

    b. Pilot phase, beginning with a review of national water management data available from a small group of countries (e.g. 4 - 5)

    c. Development of quality assurance standards for water management data.

    d. Demonstration of an approach for aggregating management indicators to provide national estimates.

Annex 1. Findings of the Water Quality Task Force

Finding 1. The classification system using 4 categories (less than 1, 1 – 10, 11 – 100, and greater than 100 CFU per 100 mL) presented in Table 5-4 of the WHO Drinking-Water Quality Guidelines should continue to be used when presenting water quality results, but should be interpreted in conjunction with an indicator of water system risk. The majority of participants agreed that there is no need to separately report higher levels of contamination (i.e. > 1,000 CFU per 100 mL). All results should be reported in terms of 100 mL volumes, even if the actual test volume is different.

Finding 2. *E. coli* should be the preferred index of faecal contamination used in global monitoring. Where JMP directly supports water quality testing, *E. coli* should be the indicator used. If data on thermotolerant coliform or Enterococci are available, the JMP could use these, aggregated with *E. coli* data, for global monitoring purposes. However, data on total coliforms, or the hydrogen sulphide assay, should not be collected and aggregated for these purposes.

Finding 3. Global monitoring of drinking-water safety should focus on both the point of consumption and the point of delivery.

Finding 4. The current JMP system for classifying water systems as improved or unimproved based on the technology used should be retained in post-2015 monitoring because of the importance of continuity with previous JMP data and based on the available evidence, which indicates that improved sources are less likely to suffer from faecal contamination.

Finding 5. The use of correction factors to indicator attainment based on data from water quality surveys may be possible on a country-by-country basis, with appropriate caveats given regarding the variability of water quality data for the technology.

Finding 6. The JMP should not include water quality data on unimproved sources in global monitoring.

Finding 7. There is insufficient evidence to exclude certain technologies from the definition of an *improved* water source based on whether it is located in an urban or rural area.

Finding 8. Although piped and borehole water is clearly less likely to be contaminated than other improved water sources, there is insufficient evidence to reclassify particular improved sources as unimproved.

Finding 9. The establishment of an intermediate target of 10 CFU / 100 mL for faecal indicator bacteria in drinking-water is not recommended because it does not incorporate a measure of water system management, places undo emphasis on a one-time measurement and is not consistent with the WHO and other international guidelines, which indicate that no level of faecal contamination is acceptable. This standard should not be taken as a measure of 'water safety'. If a microbial standard were to be retained for an Intermediate classification, <1 CFU/100 mL would be more appropriate. However, an even better approach would be to set a target that includes both microbial quality and measures of risk management.

Finding 10. Arsenic and fluoride should be included in the top tier of parameters for global drinking-water monitoring and sampling should be encouraged unless there is clear evidence of a lack of geological susceptibility, an absence of exposure symptoms in the population and prior representative sampling that did not detect these contaminants. Reporting of compliance should primarily reflect national standards, but could also reflect on global norms (e.g. WHO Guidelines).

Finding 11. A risk matrix approach, combining an indicator of water quality and an indicator of water system management, should be used in global monitoring of safe water and should be extended to accommodate typologies for both point sources and distributed water networks.

Finding 12. Household Water Treatment and Storage (HWTS) is not recommended for inclusion by JMP as a form of water quality management at the present time due to the challenges associated with obtaining accurate estimates of usage but should continue to be assessed as new measurement approaches become available.

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Annex 3. Agenda of the Water Quality Task Force

Wednesday, 20 November

Chair: Jamie Bartram, UNC

09:00 Opening of the meeting, tour-de-table, objectives and expected outputs
Bruce Gordon, WHO
Andrew Trevett, UNICEF

09:30 Background: the JMP and drinking-water quality/safety
Rick Johnston, WHO
Rolf Luyendijk, UNICEF

10:30 Refreshment

11:00 Future directions in global water quality monitoring
Tom Slaymaker, WaterAid

12:30 Lunch Break

13:30 Plenary discussion on specific questions
Moderated by Rolf Luyendijk, UNICEF

AA Reporting Microbial Water Quality: In different countries and settings, microbial data will be collected and reported with different methods, detection limits and reporting levels. JMP proposes to report data in terms of "Risk Classes" ranging from A (<1 CFU/100 mL) to E (>1000 CFU/100 mL), and to aggregate *E. coli* with TTC, and possibly other faecal indicator bacteria. Does the TF endorse this decadic classification system? Would the TF endorse aggregating different types of measures? (e.g. MPN and MF; *E. coli* and Thermotolerant Coliforms; *E. coli* and *Enterococci*; *E. coli* and H_2S…)

BB Definition of sampling points: JMP proposes a set of terms and definitions to be used consistently in reporting (e.g. point of collection, point of use…) for the TF to comment on, revise, and possibly endorse.

CC Improved/Unimproved: should these classifications be retained at all, in the case where at least some Water Quality or Management information are available? JMP proposes to do so, but to apply correction factors by technology to account for water quality shortcomings. Does the TF endorse this approach? Should JMP measure water quality on unimproved sources as well?

15:00 Refreshment

15:30 Plenary discussion on specific questions, continued

DD Basic Access: does the TF endorse the definition of Basic Access proposed by the WWG? Specifically, does the TF endorse the suggested revision to Improved/Unimproved technologies, to be different in urban and rural settings? Should dugwells continue to be considered as "Improved" sources, considering technical as well as political dimensions?

EE Intermediate Access: does the TF endorse the definition of Intermediate Access proposed by the WWG? Specifically, does the TF endorse the suggested indicator of <10 CFU E. coli/100 mL?

FF Chemical water quality: Arsenic and fluoride are not mentioned in WWG proposed text. Does the TF recommend that such parameters be included in a 'must have' tier of parameters? How should results be tracked when country standards differ?

17:30 Wrap up by the Chair – review of next day's programme

Thursday, 21 November *Chair: Andrew Trevett, UNICEF*

09:00 Recapitulation of Day 1 *John Feighery, Rapporteur*

09:30 Water quality management *Bruce Gordon, WHO*

10:00 Possible indicators: working with regulated water supply *Jennifer de France, WHO*

10:30 Refreshments

11:00 Presentations from regulators, open discussion
Richard Cheruiyot, Kenya
Helgard Muller, South Africa
Luis Simas, Portugal

12:30 Lunch Break

13:30 Plenary discussion on specific questions *Moderated by Mark Sobsey, UNC*

GG How can WQ measurements and WQM information be used in combination? Can the risk matrix (sanitary inspection vs. E. coli results) be standardized or extended to include broader management indicators?

HH HWTS can be considered as a form of water quality management, at the most local level. JMP currently collects information on self-reported HWTS practice through household surveys, though these have been criticized as representing over-estimates. Should JMP factor in reported HWTS into any integrated measure of water safety?

II Taking the long view: by 2030, how will global monitoring look? What will be the mix of information from household surveys, regulators, institutions, and other sources?

15:30 Refreshment

16:00 Plenary discussion on specific questions, continued

JJ How should monitoring for regional and global purposes link with capacity development at the national and subnational scale?

KK In the short term: what does the TF recommend that the JMP do vis-à-vis incorporation of water quality management measures into global monitoring?

17:30 Wrap up by the Chair – review of next day's programme

Friday, 22 November

Chair: Bruce Gordon, WHO

09:00 Recapitulation of Day 2

John Feighery, Rapporteur

09:30 Putting it all together: definitions and indicators for "water safety"

Rick Johnston, WHO
Rolf Luyendijk, UNICEF

10:30 Refreshments

11:00 Final discussion and recommendations on monitoring of water quality and water safety

Moderated by the Chairs

12:15 Meeting close

12:30 Lunch

Selected References

[1] International Standards Organization. 2013. ISO Standard 22000 Food Safety management. http://www.iso.org/iso/home/standards/management-standards/iso22000.htm

[2] *Impact, A Performance review of Kenya's Water Services Sector - 2010/11*. 2012. Kenya Water Services Regulatory Board. *http://www.wasreb.go.ke/wasreb/images/WASREB_Impact_Report5.pdf*