UNSGM Designated Laboratories Workshop Report

Spiez, Switzerland
9 – 11 September 2025

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Department of Defence,
Civil Protection and Sport DDPS

Federal Office for Civil Protection FOCP
SPIEZ LABORATORY

Federal Department of Defence, Civil Protection and Sport DDPS
Federal Office for Civil Protection FOCP

SPIEZ LABORATORY
The Swiss Federal Institute for NBC-Protection

CH-3700 Spiez
Tel +41 58 468 14 00
www.spiezlab.admin.ch

Contents

Acknowledgements

The tenth UNSGM Designated Laboratories Workshop took place from 9 – 11 September 2025 in Spiez, Switzerland.

The following Swiss Federal Departments made this workshop possible:

- Federal Department of Foreign Affairs
    - State Secretariat, International Security Division
- Federal Department of Defence, Civil Protection and Sport
    - State Secretariat for Security Policy, Strategy and Cooperation Division
    - Federal Office for Civil Protection, Spiez Laboratory

The organisers express particular thanks to Ralf Trapp (International Disarmament Consultant) for his help in preparing this report and Amanda Moodie Muldowney (U.S. Department of State, US) for her work as a rapporteur.

Spiez Laboratory, the Swiss Federal Institute for NBC-Protection, is responsible for the content of the report. It does not reflect an official Swiss position.

Executive Summary

This report celebrates the tenth anniversary of the Swiss UNSGM workshop series, organised by Spiez Laboratory. It presents the outcomes of the tenth edition of the series on a network of trusted laboratories designated under the United Nations Secretary-General's Mechanism (UNSGM)[1] to investigate allegations of the use of chemical, biological and toxin weapons. The workshop series is a contribution to strengthen the readiness of the UNSGM, which is part of Switzerland's Arms Control and Disarmament Strategy 2022-2025[2] and also links to the Secretary-General's Disarmament Agenda[3].

This year's workshop provided an opportunity to reflect on the workshop series over the past decade. Welcome addresses by Ambassador Pälvi Pulli from the State Secretariat for Security Policy of the Swiss Federal Department of Defence, Civil Protection and Sport, Reto Wollenmann of the International Security Division of the Swiss Federal Department of Foreign Affairs, and Izumi Nakamitsu, Under-Secretary-General and High Representative for Disarmament Affairs of the United Nations, highlighted the significant contribution that this workshop series has made to ensure that the UNSGM is fit for purpose. Specifically, it has led to the creation and promotion of a capable, robust and trusted network of laboratories and established a dedicated community that serves as an authoritative platform. This provides the UNSGM with analytical competence and quality assurance, both of which are key attributes for credibility and trust in the results of investigations concerning the possible use of biological and toxin weapons.

In light of the fact that the UNSGM remains to date the only internationally available instrument to investigate an alleged use of biological weapons, this dedicated laboratory community is of particular importance. Such a laboratory network for the UNSGM strongly depends on the sustained support of Member States and the active engagement of participating laboratories, in line with the Mechanism's Guidelines and Procedures[4] and in close coordination with the United Nations Office for Disarmament Affairs (UNODA) – the custodian of the UNSGM. It was therefore extremely rewarding to see these efforts bear fruit as early as 2017 when a first milestone was achieved through the conduct of a very first interlaboratory calibration study dedicated to the intricacies of a laboratory analysis within the context of the UNSGM. Since then, an increasing number of countries and organisations have arranged dedicated dry lab as well as wet lab external quality assurance exercises, tailored to the needs of the UNSGM. Most importantly, these exercises are also of benefit to the participating laboratories for the purpose of assessing the validity and accuracy of analytical methods, which may assist them in their accreditation efforts. The increasing variety of exercise schemes from different providers has helped to broaden the geographical participation in the network over time.

This anniversary edition of the workshop series provided an important opportunity to review and reflect on an impressive set of recent activities and developments. It also served to highlight the progress made on many subjects. This included different laboratory exercise formats and explorations of forensic aspects, the analysis of toxins, guidance and documentation as well as a range of activities of relevance for the laboratory community. The workshop also emphasised the importance of laboratories in the context of a mission, in particular the key issue of a technical arrangement between the laboratory and the United Nations that needs to be in place in order for the laboratory to be in a position to provide its services under the UNSGM.

Experiences, e.g. from the International, Impartial and Independent Mechanism (IIIM), demonstrate that the involvement of a laboratory in a UNSGM mission does not necessarily end with the completion of the mission. Even years after a mission is completed, laboratory results may be submitted as forensic evidence in judicial proceedings, should such cases come

[1] https://disarmament.unoda.org/en/our-work/weapons-mass-destruction/secretary-generals-mechanism-investigation-alleged-use-chemical
[2] https://www.eda.admin.ch/content/dam/eda/en/documents/aussenpolitik/strategien/strategie-ruestungskontrolle-und-abruestung-2022-2025-EN.pdf
[3] https://www.un.org/disarmament/sg-agenda/en
[4] Guidelines and Procedures for the timely and efficient investigation of reports for the possible use of chemical and bacteriological (biological) or toxin weapons. https://undocs.org/a/44/561

before national or international courts or tribunals. Consequently, it is particularly important for UNSGM designated laboratories to be aware that analytical laboratory results must be robust to withstand the test of time. To this end, a technical arrangement between the laboratory selected to support a UNSGM mission and the United Nations sets out the specific conditions required.

Last year's workshop had a detailed look at the key phases of the interaction between a designated laboratory and a UNSGM mission, based on practical experiences. One of the critical steps before an authentic sample can be received by a designated laboratory is the signing of a technical arrangement to be concluded between the laboratory and the United Nations. Since the timeframe for signing might be extremely compressed, advance preparations at laboratories and their respective hierarchies and chains of command are necessary. To facilitate these preparations, a group of experts has been working on a technical arrangement template, a draft version of which was presented and explained in detail to workshop participants. The draft was well received and will be further refined based on feedback received. The technical arrangement template will then be submitted to UNODA in the near future as an in-kind contribution.

Both the Organisation for the Prohibition of Chemical Weapons (OPCW) and the UNSGM have explicit mandates to investigate the use of toxins as weapons, which calls for a close coordination of the work under the two mechanisms. Efforts are under way in the UNSGM context, such as wet lab exercises in toxin analysis, whereas the OPCW is moving towards formal proficiency testing in toxin analysis. These efforts are coordinated between UNODA, the OPCW and the associated laboratories, which is critical to ensure that the international community can respond effectively to any alleged use of a toxin weapon. One important element is to gain a more comprehensive understanding of existing laboratory capabilities related to the analysis of relevant toxins. In continuing this work, it remains important to be flexible and efficient, while making best use of synergies and avoiding unwanted duplication.

The different external quality assurance exercises for laboratories remain essential for the UNSGM laboratory network. Participants were also informed in detail about the encouraging results achieved in the most recent exercises. While a high proficiency is achieved in agent identification, correct identification at strain level remains challenging, particularly in samples that contain low concentrations of the target agent, while being obfuscated by high backgrounds or difficult matrices. This makes in-depth agent characterisation and correct interpretation of measurements challenging for laboratories. However, both aspects are key to achieving robust and reliable microbial forensics capabilities. More efforts are therefore required in the future to gradually increase proficiency in these areas.

Future exercises will now gradually increase the level of difficulty, for instance by no longer disclosing the target agent, or focusing on specific aspects like genomic sequencing and interpretation thereof. The capabilities to identify and characterise at strain / isolate level will become key competencies of laboratories in the future. This goes hand in hand with microbial forensic capabilities, since this will allow for the discrimination between natural events and deliberate releases, and the identification of the provenance of a strain. Forensics requires deep characterisation of the sample and agent concerned, which means that laboratories must have next-generation sequencing pipelines at hand, since these are essential tools in that regard. To assist interested laboratories, a working group has recently been set up to develop recommendations for next-generation sequencing analysis.

The reporting template for laboratory results presented and discussed at previous workshops will remain flexible and adaptable to meet future needs. A next iteration will be soon submitted to UNODA.

The interface between a UNSGM mission and analytical laboratories has been discussed extensively at previous workshops. One critical element in that regard is linked to sample taking and analysis. Sampling guidance was therefore developed to address the needs of qualified experts working in the field, taking into account sample acceptance criteria of analytical laboratories. The effort led to the development of a whole suite of quality management system documents that are being used in training and exercises, and continuously improved based on peer reviews and feedback.

For several years, the aforementioned efforts have been complemented with other activities. Current projects include information management during the deployment of a UNSGM mission, field analysis of samples using fieldable devices, and activities geared at addressing the conduct of investigations in non-cooperative and non-permissive environments.

In conclusion, this tenth UNSGM Designated Laboratories Workshop in Spiez provided once again the opportunity to review and reflect on an impressive set of activities held over the past decade, which have been geared at substantially augmenting the readiness of the UNSGM. The progress made on many subjects was highlighted and it was discussed how these past activities address some of the remaining gaps and shortcomings. The draft technical arrangement template clarifies the relationship between the laboratory and the United Nations, but also supports laboratories to better understand their role, prepare accordingly and manage critical interfaces. Equally encouraging are the achievements in sampling guidance and laboratory reporting, which are being used in trainings and exercises, and constantly developed as essential living documents.

An important component of the UNSGM laboratories network are the external quality assurance exercises that take place on a regular basis. They provide the essence: sample analysis in various formats that ensure the continuous improvement of the performance of the participating laboratories as well as the growth in competence and geographical spread of the network. In this regard, it is very encouraging to note that robust laboratory capabilities and proficiencies are today available to support UNSGM missions effectively. Further exercises are key to not only maintaining the achieved, but also to further increase proficiency, including capabilities of relevance for purposes of attribution as well as abilities to find and comprehensively describe an unknown target. Furthermore, outreach to laboratories working in the fields of animal-only or plant pathogens is necessary, since these fields are covered by only few laboratories nominated to the UNSGM roster.

The Swiss UNSGM workshop series remains an effective platform to discuss the issues of relevance to designated laboratories and help all partners coordinate their activities and share the results and progress. The achievements over the past decade are a strong encouragement to continue this success story. This is why the eleventh UNSGM Designated Laboratories Workshop, has already been scheduled to take place from 9 to 11 September 2026.

1. Introduction

This year saw the tenth anniversary of the Swiss workshop series, organised by Spiez Laboratory, on the network of designated laboratories of the United Nations Secretary-General's Mechanism (UNSGM), which was held from 9 to 11 September 2025. Together with activities organised by other UN Member States and coordinated by the United Nations Office of Disarmament Affairs (UNODA) as custodian of the UNSGM, the Swiss workshop series aims to enhance the operational readiness of the UNSGM. This effort is part of Switzerland's arms control, disarmament and non-proliferation strategy. It is an important contribution in light of the security challenges the world faces, and the potential peril posed by advances in science and technology.

Welcome addresses by Ambassador Pälvi Pulli from the State Secretariat for Security Policy of the Swiss Federal Department of Defence, Civil Protection and Sport, Reto Wollenmann of the International Security Division of the Swiss Federal Department of Foreign Affairs, and Izumi Nakamitsu, Under-Secretary-General and High Representative for Disarmament Affairs of the United Nations, highlighted the significant contribution that the Swiss workshop series has made over the past decade to ensure that the UNSGM is fit for purpose. It has transformed an initial idea of creating a network of laboratories into a dedicated community that serves as an authoritative platform to provide the UNSGM with analytical competence, quality assurance, and member states with trust in the results of investigations concerning the possible use of biological and toxin weapons.

The UNSGM was established under UN General Assembly Resolution 42/37C of 1987 and reaffirmed by the Security Council in Resolution 620 of 1988. As an impartial, science-based, international investigative mechanism, it gives the UN Secretary-General a tool to respond to reports from Member States about alleged uses of chemical, biological and toxin weapons. It is to date, the only instrument available to the international community to investigate an alleged use of biological weapons.

Activities to ensure the UNSGM's operational readiness are being coordinated by UNODA. The UNSGM is not a standing investigative body, nor is it a capacity building mechanism. Its proficiency and readiness depend on the resources made available to it by Member States. Although not linked to the Biological and Toxin Weapons Convention, efforts to strengthen the UNSGM also contribute to developing investigative capacities that the States Parties to the Convention could draw upon.

Building up the network of designated laboratories complements the other assets of the UNSGM: qualified experts to conduct field investigations, expert consultants to render advice, and further resources from within the UN. Training courses for qualified experts nominated to the UNSGM are being offered by Member States, UN entities and partner organisations, and are coordinated by UNODA. Since 2022, the content of UNSGM training courses has been standardised. Recent and planned training courses include a whole suite of activities: virtual onboarding courses for qualified experts, courses in Safe and Secure Approaches in Field Environments (SSAFE) for surge deployment, basic and refresher training in UNSGM procedures as well as advanced training opportunities addressing investigative interviewing, bio crime scene management or sampling and transport of toxic and infectious samples. Outreach activities to Member States, implemented together with the 1540 Committee and the BWC Implementation Support Unit, further support these activities.

It is important to note that such training opportunities for qualified experts did not start with the establishment of the UNSGM back in the late 1980s. It took several years for the first

UNSGM training course for qualified experts to be provided by a Member State. The first such course was held in Umeå, Sweden in 2009. Further activities culminated in a first simulation exercise in Berlin, Germany in 2014. At this point in time, it became clear that work toward a UNSGM designated laboratories network would be highly beneficial to ensure the operational readiness of the UNSGM. Subsequent work began in 2015[5] and led to the launch of the Swiss UNSGM Designated Laboratories Workshop in the same year. Since then, an increasing number of countries and organisations have organised dedicated dry lab as well as wet lab external quality assurance exercises (in UNSGM terminology "interlaboratory calibration studies"), tailored to the needs of the UNSGM, to gain experience and share best practices. These exercises, coordinated by UNODA, help laboratories assess the validity and accuracy of their analytical methods, and might even assist accreditation efforts. Furthermore, the numerous exercises conducted so far have also helped to broaden the geographical participation in the network.

Table 1: External Quality Assurance Exercises for laboratories nominated to the UNSGM.

Member State/ Organisation	Exercise scheme	Dates
Germany / Robert Koch Institute (RKI)	RefBio Project (covers viruses, bacteria and toxins)	2017-2027
Denmark and Sweden / Technical University of Denmark (DTU) and Swedish Defence Research Agency (FOI)[6]	Dry lab analysis: genomic sequence data from bacteria	2018-2019
Germany, Denmark and Sweden / RKI, DTU and FOI[2]	Dry lab analysis: genomic sequence data from viruses	2021-2024
China / State Key Laboratory for Infectious Disease Prevention and Control (SKLID)	Wet lab exercise: 'Disease X Testing'	2022
China / Harbin Veterinary Research Institute	Wet lab exercise: 'Future Pandemic Testing'	2024

Table 1 provides an overview of the exercise schemes Member States have organised so far. These exercises aim at developing the proficiency of UNSGM roster laboratories, but they are also open to laboratories that have not been formally nominated to the UNSGM.

Over the years, microbial forensics has been a recurrent topic at the workshops. There are three stages of a microbial forensic investigation: unambiguous agent identification, comprehensive agent characterisation to possibly differentiate natural outbreaks from man-made events, and examination of evidence to help identify possible sources, links between suspected events or actors, and perpetrators of an agent release (attribution). Past UNSGM Designated Laboratories Workshops have clarified many requirements that laboratories selected to support a UNSGM investigation need to meet. These include:

- Proficiency in identification of the agent concerned: whilst many laboratories can conduct the types of analysis required in a UNSGM investigation, the targets and sample types may differ from what they normally investigate.
- A robust quality system, highest biosafety and forensic standards, and compliance with procedural requirements, such as observing the chain of custody.
- Proficient in using several orthogonal analytical techniques, since there is a need for validated methods, standard or recommended operating procedures, agreed acceptance criteria as well as curated reference standards and databases. Accreditation is desirable.
- Ability to interact closely with field investigators. Laboratory expertise should be embedded in field teams.
- Competence to prepare reports on analytical results that can withstand both technical and political / legal scrutiny, demonstrate an unbroken chain of custody, show the quality assurance and

[5] Workshops discussing the setting-up of a UNSGM designated laboratories network were held in Stockholm (June 2015), Umeå (October 2016), Geneva (April 2016) and Spiez (every year since 2015). Complementing these discussions was a workshop on toxin analysis (Berlin 2020). In 2023, the OPCW's Scientific Advisory Board issued a report on biotoxin analysis.

[6] Supported financially by the United States of America.

validation processes applied, and describe the findings as specific as capabilities allow.

- Readiness to participate in a UNSGM mission requires flexible and swift decision making at national level and awareness about the requirements and conditions that such a deployment would entail. A draft Technical Agreement / Arrangement template between a laboratory selected to support a UNSGM investigation and UNODA is being prepared to facilitate such future deployments.

The development of a trusted laboratory network is a step-by-step process of learning through practical exercises. Coordinated by UNODA, it is driven by the participating laboratories. A wide geographical background of the laboratories increases global confidence in analytical results supporting the findings of UNSGM investigations. Participation on a regular basis in External Quality Assurance Exercises demonstrates the proficiency of UNSGM roster laboratories. This helps UNODA and its expert consultants to adequately assess the capabilities of these laboratories, which in turn helps a Head of Mission in selecting the most suitable laboratories for a specific task in a particular mission.

2. Laboratories in the Context of a UNSGM Mission

2.1. The Importance of Laboratory Results Over Time

Previous UNSGM Designated Laboratories Workshops have stressed the critical role of laboratory reporting to a UNSGM mission. To that end, a reporting template that laboratories can use to report their activities and results in ways that meet UNSGM requirements has been developed and is now ready for use. However, experience shows that the involvement of a laboratory in a UNSGM mission does not necessarily end with the completion of the mission.

Investigations of the uses of chemical weapons in Syria[7] have shown that:

- As new investigation mandates are agreed and / or new analytical methods become available, laboratories may be tasked to analyse samples from previous missions for additional signatures, or samples that have not previously been analysed;
- Even years after a mission is completed, laboratory results may be submitted as forensic evidence in judicial proceedings should such cases come before national or international courts or tribunals.

For example, the International, Impartial and Independent Mechanism (IIIM)[8] collects, consolidates and preserves information and evidence of violations of international humanitarian law and human rights violations and abuses committed in Syria since March 2011. It also analyses the evidence and prepares case files to facilitate and expedite fair and independent criminal proceedings, and shares information, evidence and results of its analyses with national, regional and international courts. It collaborates with more than 100 partners (States, UN and associated entities including the OPCW, the UN's Syria Commission of Inquiry, former UN and joint UN-OPCW investigation missions in Syria, Civil Society Organisations, Non-Governmental Organisations, and individuals). It has set up a Central Evidence Repository which, amongst other forms of evidence, preserves forensic evidence, including the reporting of laboratory analyses. So far, it has received 498 requests for assistance from 17 jurisdictions and supported 247 distinct investigations conducted by 16 jurisdictions.

The IIIM is building two case files on chemical weapons use in Syria: one on the chemical weapons attack in Idlib Governorate in 2015, the other on chemical and conventional attacks in Hama and Idlib Governorates in 2017. These incidents were selected given the strength of the evidence gathered by previous investigations, the emblematic nature of the incidents, and the gravity of the crimes committed. Building such case files involves the consolidation of evidence, an independent and impartial evaluation, the application of international criminal law standards with regard to standard of proof and admissibility in court, the identification of any gaps in the evidence, and additional investigations to fill them.

Laboratory analyses can provide important evidence in the construction of such case files: for example, the identification of the impurity phosphorous hexafluoride (PF_6) in environmental samples from Khan Shaykhun enabled the samples to be linked to the synthetic route employed by Syria in the production of sarin. Other marker chemicals found in samples from the Syrian stockpile and in environmental samples from the same incident underpinned the conclusion that sarin released at Khan Shaykhun had been made using the synthetic route used by Syria. Futhermore, the degree of competence and sophistication required for the quality of agent indicated a chemical-plant-type production method. Similar chemical profiles were also found in samples from Ltamenah, linking those sarin attacks to the one in Khan Shaykhun, and to the Syrian stockpile.

[7] The OPCW's IIT presented its experiences at the ninth UNSGM Designated Laboratories Workshop in 2024; the IIIM presented its work on integrating laboratory analysis into its chemical weapons case files at this workshop.

[8] International, Impartial and Independent Mechanism to Assist in the Investigation and Prosecution of Persons Responsible for the Most Serious Crimes under International Law Committed in the Syrian Arab Republic since March 2011. The IIIM was established by the UN General Assembly under resolution A/71/248 of 21 December 2016.

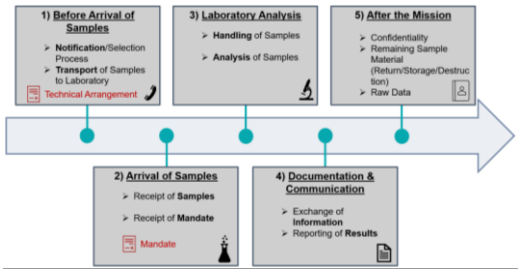
Laboratory analysis of samples taken from inside weapons remnants likewise provided evidence of the provenance of the chemicals through characteristic signatures. Together with geolocation data associated with photographic images of the locations where the remnants were found, laboratory results confirmed the authenticity. Documentation of the chain of custody proved that sarin (or sarin precursors) could not conceivably have been added after the deployment of the weapons.

These case files are being assembled several years after the original investigations were completed. Once in court, evidence will be challenged by defence teams. Representatives of the laboratories that conducted the analyses may be called upon to provide expert testimony to explain how the chain of custody had been preserved, how results of analyses were documented, what the scope and methodologies of the analyses had been, and how the results had been interpreted. In such court proceedings, the standards applied will be those of criminal trials as applied by the given jurisdiction, which may be more stringent than the standards used in the reporting of international fact-finding missions.

It is therefore important that laboratories that support a UNSGM investigation retain and protect documentation related to chain of custody, analytical procedures/instruments and results, validation data and other relevant information. Conditions to this end will be defined in a Technical Arrangement between UNODA and the laboratory selected to support a UNSGM mission.

2.2. Technical Arrangements with Laboratories

The experience of laboratory engagement in recent OPCW and UN investigations has underlined the need for advance preparations and flexibility to be able to respond to short-notice demands for laboratory support. Key phases of the interaction between a designated laboratory and a UNSGM mission were discussed at the ninth UNSGM Designated Laboratories Workshop, as shown in the following graph:



One of the critical steps before an authentic sample can be received by a designated laboratory is the signing of a Technical Arrangement between the laboratory and UNODA. This step will have to be completed within a very short timeframe (likely a few days). It requires that all actors, particularly decision makers in the line of command, are aware of the underlying expectations and likely content of such a Technical Arrangement. Designated laboratories should therefore put in place advance preparations to ensure that the necessary decisions can be taken in time by the different authorities concerned.

To facilitate these preparations, a group of experts from Switzerland and the United States has been working on a Technical Arrangement template. It can serve as a model for such arrangements rather than being a final contractual text. In particular, the template gives laboratories a better sense of what is expected of them when called upon to support a UNSGM mission. It can also be used to inform relevant authorities about the nature and short timeframes for the necessary decisions so that a UNSGM mission can be conducted with laboratory support.

The draft Technical Arrangement template was introduced and explained at this workshop. It contains a section with General Provisions, as well as several Annexes.

The General Provisions section deals with the nature and principles as well as basic requirements for the contract between UNODA and

the supporting designated laboratory. These provisions are likely to require advice and decisions by higher authorities rather than the designated laboratory itself. This is why awareness raising and advance preparations involving these authorities are important.

Annex 1 contains technical guidelines for the off-site analysis of the samples. It deals with:

- Activities before arrival of samples at the designated laboratory (confirmation of readiness and notification of selection to receive samples);
- Transport of samples and UNSGM escort (UNSGM escort, sample reception at the point of entry, sample reception at the laboratory, unpacking of samples);
- Handling and analysis of samples (storage of sample material, handling of sample material, analysis of samples, reporting);
- After sample analysis (handling of remaining sample material, waste, and confidential information, return of sample material to the UNSGM).

Annex 2 contains information on the laboratory and the UN, and Annex 3 sets out the secrecy agreement and an attestation form for laboratory readiness.

The details of the draft Technical Arrangement template were reviewed during the workshop. Issues that were flagged in the comments included, amongst others, the desirability of guidance on the presence of escorts and the potential usefulness of a hub laboratory for purposes of sample processing and splitting according to the specific instructions of the UNSGM mission.

Participants were invited to review the draft and submit any further comments to the authors. The revised Technical Arrangement template will then be submitted to UNODA as an in-kind contribution.

3.Analysis of Toxins

Previous UNSGM Designated Laboratories workshops have already looked at the particular challenges that toxin analysis poses for a UNSGM investigation. Relevant concentrations of toxins are much lower than in the analysis of other chemical agents, and there are differences between high and low molecular weight toxins which affect the analytical methods to be used. Furthermore, there is a broad range of international, regional and national actors and networks that perform toxin analysis.

3.1 OPCW's Role in Biotoxin Analysis: Path Forward and Harmonisation with the UNSGM

Toxins are covered by the Biological and Toxin Weapons Convention, the Chemical Weapons Convention and the UNSGM. Both the OPCW and the UNSGM have explicit mandates to investigate the use of toxins as weapons, which calls for a close coordination of the work under the two mechanisms. The basis for this cooperation is set out in the UN-OPCW Relationship Agreement.

At this workshop, the OPCW provided an update on the practical work it undertakes to further develop its toxin analysis capacity. As already reported at the ninth workshop, a Temporary Working Group of the OPCW's Scientific Advisory Board reviewed relevant science and technology and considered issues to be taken into account in investigations of alleged biotoxin use. This review lasted from 2021 to 2023, involved 15 experts from 15 States Parties who met in 7 meetings to produce a report containing 23 recommendations[9]. The report identified 9 biotoxins or biotoxin families as most relevant, including both low and high molecular weight toxins[10].

The Scientific Advisory Board recommended that the OPCW should develop minimum specification requirements for performance criteria of immunological and activity assays for the analysis of high molecular weight biotoxins, and that this be conducted in partnership with the UNSGM laboratory network. It also recommended that the OPCW should review the reporting criteria for the analysis of such biotoxins together with representatives of OPCW designated laboratories and UNSGM-affiliated laboratories. Furthermore, the Board recommended that the OPCW should work closely with the UN and other interested organisations and laboratories. With the aim of establishing an informal network for biotoxin analysis to facilitate building international capabilities for the forensic analysis of biotoxins.

A first step in implementing these recommendations is a three-year project on the analysis of biotoxins financed through the Global Partnership by the UK Ministry of Defence. Under the project, analytical techniques and methods are being developed and a detection kit for ricin is being validated. To strengthen the relationship between the OPCW and the UNSGM in the field of biotoxin analysis, several meetings were held in 2023 and 2024. In addition, a survey was sent to UNSGM roster laboratories that was followed up by calls conducted between OPCW, UNODA and interested labs. Finally, in February 2025 a biotoxin workshop was held at the OPCW's Centre for Chemistry and Technology. This workshop followed up on the Scientific Advisory Board's recommendation to identify laboratories that possess specialised capabilities for the analysis of each of the "most relevant" biotoxins. The two-day workshop involved 39 participants from 21 countries and a further 61 online observers. It focused on the detection and analysis of abrin, aflatoxins, botulinum neurotoxins, epsilon toxin, staphylococcal enterotoxins, T-2 toxin, and tetrodotoxin. It reviewed challenges, experiences with and novel methods for the detection and characterisation of a range of biotoxins, and discussed validation programmes for biotoxins as well as current global capabilities and challenges in biotoxin detection. It also attracted participation from laboratories that have not previously participated in discussions about OPCW / UNSGM investigations, including laboratories with expertise in plant toxin

[9] The report is available at the OPCW website as document SAB/REP/1/23 (April 2023).
[10] High molecular weight toxins: Abrin, Botulinum neurotoxin A, Epsilon A, Ricin, Staphylococcal enterotoxin B; low molecular weight toxins: Aflatoxin B1, Saxitoxin, T-2 toxin, Tetrodotoxin.

analysis. The workshop provided a more complete understanding of existing laboratory capabilities related to analysis of the relevant biotoxins. The OPCW's current focus is on a continuation of the discussion focused on high molecular weight toxin analysis, the incorporation of lessons learned from the OPCW Trial Proficiency Tests on biotoxins, and the preparation of a workshop on clinical aspects of biotoxin exposure.

3.2 Trial OPCW Biotoxin Proficiency Tests

Following a series of seven exercises, the 1st Trial OPCW Biotoxin Proficiency Test was conducted from August 2024 to March 2025[11]. It was scenario-based, involving an attempted poisoning event involving saxitoxin. The matrices used were algae media and commercial apple juice, with spiked target concentration of the test samples at 40 ng/ml. Five identification points were required for passing the test, using at least two different analytical techniques, of which the primary technique had to be data rich. Reports had to be submitted within 15 calendar days.

A total of 27 laboratories from 21 States took part in the trial. 22 of the participating laboratories identified and reported all spiking chemicals with sufficient analytical data, scoring an A. One laboratory scored a B, also passing the test, whereas false-positive results were reported by the remaining four laboratories. This brought to 88 % the percentage of participants that demonstrated proficiency in identifying Saxitoxin in the framework of this first trial biotoxin proficiency test for verification purposes.

A 2nd Trial OPCW Biotoxin Proficiency Test on the analysis of ricin had just begun at the time of the workshop. The reports will be evaluated during October and November 2025, and a meeting to discuss the preliminary results is scheduled for February 2026.

The OPCW's move from exercises to trial proficiency tests is a step towards establishing a third scheme of OPCW proficiency testing and designation for the analysis of verification samples, explicitly adding toxins to the scope of OPCW laboratory designation for verification purposes. As a result of the OPCW exercises and the 1st Trial Biotoxin Proficiency Test, analytical methods and scoring systems have been harmonised, and separate sets of guidelines are in place. The competence of the OPCW laboratory network in the verification of incidents involving saxitoxin has been demonstrated under a proficiency test scheme. Next steps will involve the consideration of comprehensive guidelines for both high and low molecular weight toxin analysis, and the spiking of similar yet non-scheduled chemicals and / or degradation products of biotoxins. The OPCW is gathering feedback from participating laboratories on a future proficiency test scheme. At the policy level, briefings and discussions are under way with States Parties of the Chemical Weapons Convention and the OPCW's policy-making organs about moving towards official OPCW Biotoxin Proficiency Tests and the designation of laboratories for the analysis of verification samples for biotoxins.

[11] For a summary see OPCW document S/2385/2025 (21 March 2025).

4. Sampling Guidance and Related Training

The need to develop sampling guidance that would address both the requirements of qualified experts working in the field, and take account of sample acceptance criteria of the analytical laboratories assigned to support a mission, was first identified at the third UNSGM Designated Laboratories Workshop in 2017. Canada took the lead in developing such guidance as part of a broader package of field investigation guidance. It presented a comprehensive suite of Recommended Operating Procedures to UNODA at the Wilton Park Conference in 2019, in preparation for the Capstone Exercise in Germany. This process was supported by peer reviews and feedback from experts from Australia, Canada, France, Germany, Switzerland, the United Kingdom, and the United States. These documents covered all aspects of a UNSGM mission, from policy options to field guidance. They were organised along a quality management structure, covering key areas from general quality management to mission planning and support; command, control and communications; health, safety and security; confidentiality and information management; investigation-related activities; and sampling.

With regards to sampling, the package addressed biomedical sampling, environmental biological sampling, and sample packaging and transport. The guidance documents follow the UNSGM Guidelines and Procedures as per document A/44/561. They briefly explain purpose and scope, address general planning and equipment issues, describe the equipment to be used, the handling and collection procedures, set out documentation requirements including example forms and a chain of custody form, and provide a field guide. The sampling process is shown in a colour-coded graph to visualise the requirements.

The Capstone Exercise used some of these guidance documents and procedures. UNODA has now transformed them into practice notes, which are being used in UNSGM trainings. They are being updated based on feedback from participants. In this way, the trainings advance the skills of technical experts and optimise the processes used by UNSGM investigation teams.

Furthermore, the guidance documents have been aligned with an INTERPOL biological crime scene management course. This course takes trainees through a 12-steps bio-crime scene investigation, from arrival at the scene to the transportation of the evidence for further investigation / analysis off site. It contains practical instructions on note-taking, on setting up a biological sampling stand, and other aspects of managing a bio-crime scene. In February and March 2023, 28 qualified experts nominated to the UNSGM by 24 countries took part in the course. It demonstrated that UNSGM and INTERPOL materials merged well and that its core principles suit the training needs of the UNSGM. A second course involving 20 roster experts from 18 countries was conducted in August 2024. UNSGM documentation was used in this course and forensic photography was added to the course content. A next bio-crime scene management training course will be conducted in November 2025 at the UN Global Service Centre in Brindisi, Italy.

Furthermore, a skill training course on sampling and transport of infectious substances is now available for qualified experts of the UNSGM. This is a modular training course addressing regulatory issues of transporting toxic and infectious substances as well as sampling in the context of a UNSGM investigation. Two such courses were offered by the Robert Koch Institute in Germany in 2023 and 2024. A further course will be held in November 2025, with the Public Health Agency of Canada supporting the sampling module.

In sum, the UNSGM has a comprehensive package of quality management system sampling protocols at its disposal, which are continuously improved based on peer reviews and feedback from use in training and exercises. Other such protocols and documents have also been submitted to UNODA. This creates an opportunity to foster synergies in UNSGM training offered by different Member States and ensure continuity and product development. In terms of sampling, the collaboration with partners of the UNSGM in the areas of bio-crime scene management will continue. More work is planned to further refine sample protocols for

air transportation of samples and enhance the basic refresher course in partnership with experts from Portugal and South Africa.

5. Exploring Forensic Aspects in Exercises

Given the nature of biological agents, a key challenge for a UNSGM investigation is the discrimination between natural events and deliberate releases, and the identification of the provenance of a strain. This requires deep characterisation of the agent concerned, including signs of genetic manipulation, mutation bias, similarities / relationships to known strains, or unexpected genetic patters with regards to antibiotic resistance, virulence determinants and other features. For these tasks, next-generation sequencing is an essential tool.

In recognition of these challenges, the German RefBio project has gradually been increasing the level of technical difficulties that laboratories participating in its External Quality Assurance Exercises face, when characterising the target agent and the matrix background.

As the required depth of analysis increases further, next-generation sequencing will become mandatory in RefBio exercises from 2025. An additional challenge starting in 2026 will be low target concentrations and unknown agents. These developments are critical to ensure that future laboratory investigations related to questions of attribution will be robust and capable of delivering accurate results. It is important to note that each step in the workflow for strain characterisation bears unique challenges and requires decisions that will influence the analytical success. The main challenges include:

- Inhibition of DNA extractions or downstream analysis by the matrix (e.g., EDTA blood, soil with high humic acid content);
- Failure to extract sufficient DNA / RNA (selection of the extraction method, hybrid capture as a method of choice to extract full genomes from complex samples, limited sample volume available for elution, elimination of inhibitory substances);
- Insufficient sequencing depth (pure cultures *vs*. metagenomic data sets, target enrichment prior to sequencing);
- Wrong sequencing platform for typing (e.g., ONT);
- Unoptimised assembly pipelines;
- Incomplete or inaccurate genomic databases for typing;
- Failure to detect and to extract target-specific reads from metagenomic data;
- Lack of accurate typing assays (e.g., cgMLST/SNP, etc.).

Previous wet lab exercises have shown that less experienced laboratories face significant difficulties to master these challenges and interpret sequencing data correctly. Some laboratories were able to generate perfectly correct genomes but lacked expert knowledge to capture important information.

To help overcome these problems, RefBio has set up a working group to develop recommendations for next-generation sequencing analysis. Twelve institutions from Australia, France, Germany, Hungary, the Netherlands, Portugal, Spain, Sweden, Switzerland and the United States are part in this working group. Its main objectives are to:

- Develop recommendations / protocols for:
    - DNA extraction from different matrices,
    - NGS analysis (assembly strategies, microbial profiling techniques),
    - Quality criteria for raw data and assemblies from public databases (e.g., coverage, sequencing technology, assembler);
- Identify, compose and provide:
    - A set of curated, reliable references genomes as a starting kit for individual databases,
    - Sequencing data training sets;
- Facilitate knowledge exchange:
    - Establish a data exchange platform to share knowledge.

These efforts were welcomed by workshop participants and will be critical as the designated laboratories network moves closer to addressing microbial forensics for the purpose of attribution.

6. Laboratory Exercises

6.1 RefBio Project Overview

The RefBio project to strengthen the diagnostic capabilities of the UNSGM roster laboratories began in 2017. Implemented by the Robert Koch Institute, it is funded by the German Federal Foreign Office and currently in its third phase (2025-2027). It addresses sample transportation, laboratory analysis, and reporting of laboratory results.

Each year, the project offers three External Quality Assurance Exercises covering bacteria, viruses, and toxins. The project also provides laboratory trainings to facilitate the exchange of methods and enhance analytical capacities of participating laboratories. In addition, workshops are held on a regular basis to evaluate the results of the exercises, plan future exercises, and share experiences and best practices.

Since the inception of the project, the geographical participation of laboratories has steadily grown.

The participants are primarily UNSGM roster laboratories. Samples include infectious and non-infectious samples and comply with UNSGM and international standards. The target agents are highly pathogenic bacteria, viruses and toxins, and the difficulty of the exercises has increased gradually over time. Until 2025, the target agents were known to the participants; as from 2026, the exercises will involve undisclosed targets.

This signifies a gradual shift from agent identification at species level and subtyping towards identification and characterisation at strain / isolate level by using complex matrices and genetic manipulations of the target agents, such as atypical virulence patterns, antibiotic resistance genes and other peculiarities. An additional difficulty will be the shift towards identification and characterisation of undisclosed targets. In terms of analytical methods needed, this increased complexity requires a shift from molecular diagnostics to in-depth molecular characterisation using next-generation sequencing techniques, metagenomics and comparative genomics. The recommendations from the new working group are aligned with this. In future bacterial and viral exercises, next-generation sequencing approaches will become mandatory. The exercises will also address chain of custody and data security issues, and the work on further refining the reporting template will continue.

6.2 RefBio Exercises on Bacteria

The RefBio bacterial exercise 2024-2025 involved the identification and characterisation of *Yersinia pestis*. 30 laboratories from 19 countries took part. The tasks included identification (positive / negative samples, plasmid content) and characterisation (bacterial strain, antibiotic resistance pattern, virulence genes, optional: molecular profiling). Some of the laboratories faced challenges, such as:

- Living samples were not cultivable;
- Differentiation between target and non-target agents;
- Sample matrix inhibiting downstream workflows;
- Difficulties linked to DNA extractions to reach the concentration required for next-generation sequencing in complex samples;
- Limited availability of analytical methods.

In addition, differential diagnostics required decisions about which agents were part of the natural background, and which not.

Most of the participating laboratories identified *Y. pestis* correctly. When it came to deeper characterisation, the biggest difficulty was the identification of the bacterial strain in living samples, which 5 of the 19 laboratories that completed this task failed. For inactivated samples, the success rate was 53-60%. Data on antibiotic resistance and virulence genes posed the greatest challenge in interpretation of results.

After the exercise, an online training on identification and characterisation of *Y. pestis* is scheduled for November / December 2025, providing an overview of microbiological and molecular tools as well as an introduction to taxonomic profiling and the implementation of specific workflows using computational analysis. The next bacterial exercise will start in October 2025 and involve the identification and characterisation of *Francisella tularensis*.

Looking back at the entire RefBio period from 2017 to 2024, the exercises showed a high proficiency in agent identification, but low proficiency

in identification at strain level, further characterisation as well as interpretation of the results.

6.3 RefBio Exercises on Viruses

Past RefBio viral exercises involved the identification and characterisation of orthopoxviruses (2018 and 2019), SARS-CoV-2 (2020), haemorrhagic fever viruses (2021), encephalitis viruses (2022) and mpox virus (2023). The general tasks of these exercises included species identification, characterisation by strain and mutations of the genome, and identification of irregularities (contamination, recombination, artificial DNA fragments). The challenges included low virus concentration, low sample quality and inhibiting background. The methods involved were PCR for identification and next-generation sequencing for characterisation.

The 2024 / 2025 exercise used filoviruses as targets and serum, urine and EDTA-blood as matrices. The tasks given to the participants ranged again from identification of positive and negative samples for filoviruses as well as identification at species and strain levels. Furthermore, other pathogens in the sample and irregular features had to be identified.

Identification of the positive / negative samples and the genus was correctly accomplished by all participants. The species was correctly identified in 97.3% of the cases. Identification success at strain level was at 93.4% for those laboratories that performed the task.

Comparing the results of the exercises from 2018 to 2024 (both on filoviruses), one can conclude that there has been a gradual improvement in proficiency in genome characterisation and the detection of signatures of genetic engineering. In general, laboratories rostered for the UNSGM have a high proficiency with regards to species identification, yet low proficiency at the level of strain identification and the detection of variants and mutations. Proficiency in genome characterisation will be important for forensic investigations.

Since 2018, a total of 35 laboratories participated in the viral exercises, 9 of which took part in all 6 viral exercises, and 21 in at least four exercises. Of these 21 laboratories, 19 also took part in dry lab exercises organised under the UNSGM.

After the 2024 exercise, a training on sequencing data of filoviruses was offered in November 2024. Participation in dry lab exercises further strengthens the capability of laboratories in sequence data analysis. This is important as the inclusion of genetically engineered viruses in wet lab exercises would be difficult to accomplish. Additionally, dry lab exercises alleviate many of the challenges of wet lab exercises resulting from export / import regulations, shipment costs, and the associated high workload. The datasets used in this training were challenging, and the performance of laboratories, whilst high for species identification, fell below 90% with regards to the description of genetic engineering; for one data set it was as low as 57%.

The next RefBio virus External Quality Assurance Exercise is scheduled for October 2025. It will use inactivated arenaviruses as target and participants will again be asked to perform a range of tasks ranging from identification to characterisation of the genomes. This will be followed by a dry lab training on arenavirus genome characterisation and genetic engineering.

6.4 RefBio Exercises on Toxins

Between 2019 and 2024, RefBio conducted five toxin External Quality Assurance Exercises. On average, 14 laboratories from 12 countries participated in these tests. The targets included ricin and abrin (two exercises), botulinum neurotoxins (two exercises) and *Staphylococcus* enterotoxins (one exercise). These toxins have high relevance for bioterrorism, contain large numbers of variants, and demand advanced techniques for diagnostics. With increasing levels of difficulty, the tasks given to the participants ranged from identification of positive / negative samples to characterisation (toxin quantification, activity, identification of subtype / variant and specific questions related to source attribution, including matrix composition and purity of the toxin).

The 2024 exercise had *Staphylococcus* enterotoxins as targets, and different kinds of matrices (buffer, a soy-based cocoa drink, cream cheese, artificial stomach juice and a cell-free bacterial supernatant). A particular challenge was the high variability of *Staphylococcus* enterotoxins with more than 30 types and variants. The methods used by the laboratories included immunology, mass spectrometry, functional assays and DNA based microbiological / molecular biology techniques.

In the qualitative tests, 8 of the 12 laboratories specifically addressed five *Staphylococcus* enterotoxin types (SEA-SEE), and most laboratories specifically addressed SEB. 90% of the positive samples were correctly identified, but there were some false-negatives caused by sensitivity and matrix issues (low pH). Of the negative samples, 98.4% were correct results. False-positive results were due to cross reactivity and matrix issues (supernatant). Although the overall final assessment showed a 97.2% success rate, the most challenging samples scored only 88% (supernatant matrix with SEA, SEB and SEC) and 80% (simulated stomach juice samples at pH 1.5 containing SEB and SEC).

In the quantitative tests, most laboratories only quantified SEB, with a total success rate of 87.8%. The most challenging sample was SEB in buffer with a success rate as low as 64.7% due to a low concentration of the target. Mass spectrometry as well as molecular biology tests provided information regarding the questions relevant to source attribution: the absence of toxin-coding DNA and only few *S. aureus* components were indicative of purified toxins.

In conclusion, UNSGM roster laboratories show a high proficiency when it comes to identifying positive / negative toxin samples (depending on the toxin, its variants, and the matrix), but there remains room for further improvement. Only advanced laboratories are able to identify toxin variants, quantify toxins precisely, further characterise samples (e.g., measuring toxin activity, detecting accompanying substances and matrix components), and accurately interpreting test results (e.g., with regards to indicators for deliberate production or purification, or sample identity). There is a need for further exercises and the exchange of practices and methods.

A sixth toxin exercise will be conducted from September to October 2025. It will use botulinum neurotoxins, serotypes A, B, E and F, as targets. The focus will be on protein detection, quantification, activity and molecular biology. Options for future exercises include a further increase of difficulty combined with progress review, or mixed panel from previous exercises as target.

RefBio has also offered virtual trainings on toxin analysis. These addressed sandwich ELISA for ricin and botulinum neurotoxins as well as suspension immunoassays (multiplex). In December 2025 a training on functional botulinum neurotoxin detection (Endopep-MS and Endopep-SIA) will take place. On average, 40 participants from 15 countries have signed up for these courses. They involve presentations from network partners and discussions on minimum validation parameters, performance criteria, and the content of laboratory reports in the context of a UNSGM mission.

6.5 Impressions from Participating Laboratories and Outlook to Future Exercises

Representatives from five laboratories that have taken part in recent External Quality Assurance Exercises presented their impressions and lessons-learned. These included DSO Singapore, VERIFIN Finland, Spiez Laboratory Switzerland, and Dstl United Kingdom.

They highlighted distinct benefits for laboratories participating in these exercises. Key points included:

- The possibility to evaluate protocols, also with a view to supporting accreditations;
- Maintenance and continuous improvement of analytical and other skills:
    - Learning new methods and analytical strategies,
    - Optimisation of sample usage,
    - Maintenance of the quality assurance system,
    - Development of new skills and strategies in response to actual outbreaks (e.g., during the 2018 mpox virus outbreak);
- Identification of gaps:
    - Curation of databases,
    - Refinement of Standard Operating Procedures,
    - Improvement of bioinformatic pipelines, for example for complex tasks such as identification and characterisation of unknown agents in complex matrices and involving different host species (source of origin tracing),
    - Management of computation times needed for deep sequencing of large sample numbers (risks and opportunities of data filtering);
- Training of staff;
- Possibility to compare the laboratory's practices and performance with other network members:
    - Benchmarking,
    - Sharing of different approaches and practices about such issues

as preparation of samples for exercises.

The External Quality Assurance Exercises offered in the context of the UNSGM are not "just another exercise", but rather meticulously tailored to the specifics of the UNSGM. The increasing difficulty levels of the tests is a challenge for even the best laboratories. Decreasing target concentration, complex matrices and taskings that aim at detecting signatures that could be of value for the purpose of attribution, ensure that the exercise scenarios are increasingly reflecting real-world investigation cases. At the same time, the exercises are bringing participants (individual experts as well as laboratories) closer together – team building that increases confidence in the ability of UNSGM roster laboratories to effectively respond to the demands of a real investigation.

For the future, participants stressed that it would be desirable to work towards international Recommended Operating Procedures, taking inspiration from the Blue Book[12] in the field of chemical weapons disarmament verification. Continuing the efforts with regards to toxin analysis is important, including the close coordination and cooperation between the UNSGM and the OPCW in this field.

Finally, a representative of France informed about an upcoming laboratory exercise to be hosted and organised by DGA CBRN defence, France. In coordination with UNODA, this dry lab External Quality Assurance Exercise is planned for February 2027 and will involve the analysis of genomic sequence data from bacteria. A feedback webinar will be held during the summer of 2027.

[12] The next issue of the Blue Book is planned for 2028: Blue Book | VERIFIN | University of Helsinki

7. Reporting Template for Laboratory Reporting

At the ninth UNSGM Designated Laboratories Workshop a draft laboratory reporting template, developed by a working group consisting of RefBio representatives and external experts over a period of several years, was presented and discussed in some detail. This template needs to satisfy the requirements of the UNSGM, while also being customisable to a specific context and providing flexibility to analytical laboratories.

The draft template builds on previously developed documents, discussions in the working group and feedback from experts from France, Sweden, the UK and the OPCW.

The draft template offers two options to structure a laboratory report to the UNSGM mission: laboratories can either use a recommended reporting format ready to be completed, or they can use their own reporting structure whilst using the template as a guide to include all the necessary information. The Reporting Template was submitted to UNODA in February 2024 in the understanding that it was ready for use, but as a living document which would see further refinement based on feedback from trainings and exercises. A first such evaluation was conducted by the Robert Koch Institute using the data from the 2023 RefBio exercise. A broader evaluation at the end of 2024 included feedback from some 15 laboratories that had participated in the 2023 exercises and final adjustments by the RefBio team and its working group.

This broader evaluation resulted in some major improvements to the template, including:

- Optimisation and addition of tables directed to the analysis of bacteria, viruses and biotoxins, respectively (including single nucleotide polymorphism (SNP) analyses, multi-locus VNTR analyses (MLVA), multi-locus sequence typing (MLST));
- Room for reporting on several targets (e.g., genes, proteins, drugs for resistance / susceptibility testing).

The updated template has kept the concept of a single main reporting document applicable to all analytes. It is a basic template that allows laboratories to provide the most important information to the mission and at the same time facilitates the interpretation of the results. It is adaptable to the specifics of the mission, and there are now three separate documents adapted for the reporting of results of the analysis of bacteria, viruses, and toxins. An additional document with comments and explanations serves as an FAQ-guide, and on request, laboratories can also obtain an example of a completed report.

Part 1 of the main report contains information on the laboratory submitting the results. This part can be separated from the rest of the report to ensure anonymity.

Part 2 contains the analytical plan, a summary of the analyses, and detailed reporting tables with two options: either using the laboratory's own reporting format (option A) or the provided template (option B). Part 2 also provides guidelines on reporting the results on agent identification and characterisation for laboratories opting for their own reporting format. Even though two options have been retained in the template, future RefBio exercises will require reporting using the Reporting Template as provided with option B.

The reporting structure is set out in several tables: The main tables (blue) provide information on key analytical steps and results (isolation and detection / identification of agents; screening for phenotypic drug resistance / antimicrobial susceptibility testing; characterisation of the agent by molecular typing; identification of virulence genes; identification of resistance genes; serological screening in clinical samples; functional activity of toxins; identification of other characteristics). Key data of the underlying tests and measurements are then reported in a second set of tables (grey); for example, laboratories would record here the target agent identified; specify the gene, sequence, plasmid, antigen or peptide; provide measurement data; and provide descriptions and other information such as references to supplementary data / graphs.

Part 2 also contains Appendices, which would be used to provide detailed information on the methods used, including key quality parameters and validation.

Participants in the workshop were invited to provide any further comments on this version 2 of the Reporting Template, before it is finalised over the coming months and submitted to UNODA as a revised version. In coordination with UNODA, it will also be shared with interested laboratories.

The template is ready for use in UNSGM External Quality Assurance Exercises and will be used by RefBio in its future exercises. It remains a living document that will be adapted based on experiences from practical uses.

8.Further Projects of Relevance for Laboratories

The United States of America are sponsoring three other projects that complement the work on the designated laboratory network and related sampling procedures. These include:

- Field analysis of samples using a MinION device (in collaboration with DTU Denmark and FOI Sweden):
  - The goal is to find alternatives to shipping samples from the field to off-site designated laboratories to circumvent potential problems with customs clearance and other issues that could delay sample transfers,
  - Studying options for MinION use with limited internet access;
- Information management during the deployment of a UNSGM mission (in collaboration with VERTIC):
  - The goal is to develop approaches / tools to manage information during an ongoing investigation and preserve evidence,
  - Experience from previous investigations is being analysed,
  - Different technical solutions are considered ranging from made-for-purpose software to simple spreadsheets; work with the UN to find simple solutions involving a secure SharePoint site is ongoing;
- Conduct of investigations in a non-permissive environment (in collaboration with the Stimson Center):
  - Need to consider non-permissive scenarios (war zone, internal conflict, extreme weather or geographical conditions), non-cooperative scenarios (lack of experience of host country in escorting investigations, deception strategies), and a combination of the two.

The projects are being implemented through workshops involving UNODA and the UN internal task force. These workshops have broadened awareness of problems, reviewed possible solutions, and will help future missions to conduct investigations more effectively. The reports will be circulated via UNODA.

.

9. Accomplishments, Future Priorities and Next Steps

This tenth UNSGM Designated Laboratories Workshop in Spiez has again provided important opportunities to review and reflect on an impressive set of activities to strengthen the operational capacity of the UNSGM and to highlight the progress made on many subjects. It also provided a platform for identifying remaining gaps and shortcomings as well as to discuss where future priorities lie.

One important field was toxin analysis. Efforts are under way in the UNSGM context, such as wet lab exercises in toxin analysis. The OPCW is moving towards formal proficiency testing in toxin analysis and is engaging with a broader laboratory community to marshal competence in analysing high-risk toxins not listed in the Schedules of the Chemical Weapons Convention. These efforts are coordinated between UNODA, the OPCW and the associated laboratories, which is critical to ensure that the international community can respond effectively to any alleged use of a toxin weapon. Discussions about how exactly to frame these collaborations will need to continue to ensure flexibility and efficiency, avoid unwanted duplication and enhance synergies between the different projects.

Further progress has been made on a template for Technical Arrangements between laboratories called upon to support an UNSGM mission and UNODA. Not only does it clarify the relationship between the laboratory and the UN, but it also helps laboratories to better understand their role, prepare accordingly and manage critical interfaces. The template can facilitate necessary arrangements between roster laboratories and other national authorities in advance of what may be an extremely short turnaround, for example customs clearance, importation permits and the like. It is designed so that laboratories can review their role and responsibilities ahead of time, identify any potential issues, and make preparations to ensure that a Technical Arrangement can be signed when needed on very short notice.

Much progress has also been made on sampling (guidance documents, notes, training, collaboration with INTERPOL), and the reporting of laboratory results to the Head of Mission in a UNSGM investigation (Reporting Template). These documents have been submitted to UNODA. These living documents are being used in UNSGM trainings and exercises and will be reviewed and further refined based on feedback from participants in those activities.

One of the most significant achievements in developing the UNSGM designated laboratories network has been the regularity of External Quality Assurance Exercises offered by Member States, most notably Germany with its Ref-Bio project, two wet-lab exercises conducted by China and the dry lab bioinformatics exercises run by Denmark, Sweden and Germany with support from the United States. These regular exercises are critical to ensure the continuous improvement of the performance of the participating laboratories as well as the increase in competence and geographical expansion of the network. Participants share experiences and protocols, develop concepts and guidelines, and identify opportunities for collaborations. The exercises have become ever more challenging and are increasingly testing proficiency in forensic-type analysis that is essential for attribution tasks.

As a result of all these activities and sustained commitment, the operational capacity of the UNSGM has increased significantly over the past ten years:

- Laboratory capabilities and proficiencies are available today to effectively support UNSGM missions;
- There are variations in proficiencies between UNSGM roster labs, which emphasises the need for targeted support and specific training to increase laboratory proficiencies of less advanced laboratories;
- Continuous exercising is crucial to maintain and further increase proficiency, ensuring consistent and reliable results across all laboratories;
- For attribution purposes, it is essential to further improve proficiency in areas

such as microbial profiling, interpretation of next-generation sequencing data, and the further development of chain of custody requirements;

- Furthermore, analytical approaches based on agent lists depend on the comprehensiveness and accuracy of the databases used by the different laboratories. As laboratories begin to look for unknown targets, and cognisant of advances in the life sciences with regards to artificial biological constructs that may differ in sequence but show pathogenicity similar to known agents, new methodologies that combine traditional analytical methods with functional approaches may need to be discussed.

RefBio's next-generation sequencing working group has begun developing recommendations and protocols to mitigate the challenges encountered by a number of laboratories in conducting strain identification with metagenomics with complex background. The results of this work will be important for broadening the UNSGM's capabilities to provide evidence leading to attribution in case of deliberate releases of biological agents.

Broadening the geographical diversity of the UNSGM designated laboratory network remains important for the credibility of the mechanism. Some progress has been made with increasing the global pool of laboratories available to the UNSGM, as evident from the participation in various laboratory exercise schemes. There remain underrepresented regions, such as Africa and Latin America, and further efforts are needed to engage with these regions. In other regions, working more closely with regional initiatives to strengthen laboratory capabilities would be desirable. Another issue is the identification of laboratories that are not on the UNSGM roster but have special competencies that might be needed in a particular UNSGM mission.

At the same time, bringing newcomers to the UNSGM up to the proficiency level that other laboratories have acquired through participation in ever more challenging exercises will be crucial. Getting the balance right between increased diversity and enhanced levels of proficiency will remain challenging, and underlines the need for training, sharing of expertise and good practices, and continuous improvement of performance. This will help Heads of Mission to select laboratories with the right competence and proficiency for the tasks in hand. It will also give Member States confidence in analytical results that underpin the findings of UNSGM investigations.

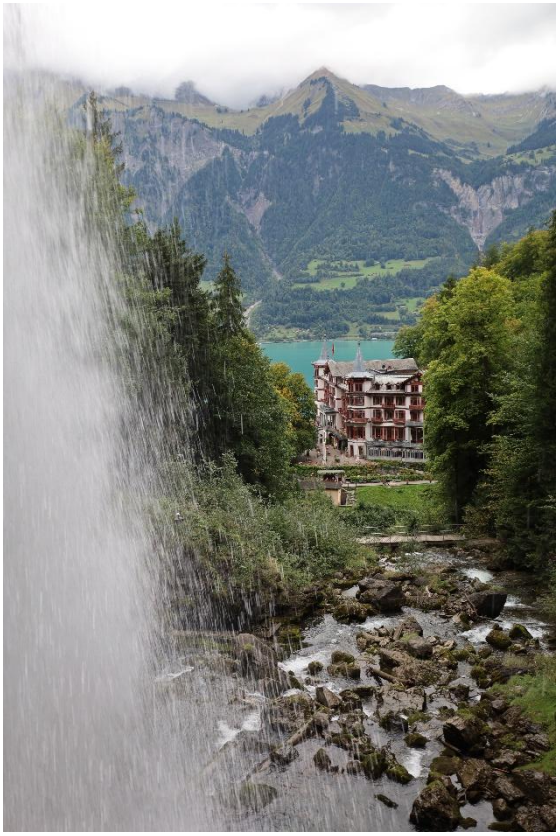
It was noted again that only few laboratories nominated to the UNSGM roster work with animal-only or plant pathogens. Similar to the work on toxin analysis, it may be necessary to reach out to other laboratories in this field to ensure that incidents involving these pathogens can be successfully investigated.

Sustained funding for the network activities will continue to be of concern. Members of this community have been successful in securing financial support for the activities towards the creation of the UNSGM designated laboratory network. This has been critical for the progress made over the last decade. Attracting funding for past and present activities has not been easy and is likely to become even more difficult with current worldwide financial restraints. Some have suggested that regional approaches to laboratory exercises and other activities might help in this regard.

Continuity and sustainability remain critical to ensure that the UNSGM continues to be fit for purpose. A further enhancement of the proficiency of its laboratory network and a wider geographical participation in this effort will remain key objectives. The partnership of international, regional and national organisations in support of the UNSGM is becoming stronger. In this multilateral effort, the workshop series organised by Spiez Laboratory remains an effective platform to discuss critical issues and to stimulate and manage collaborations, as well as to help partners coordinate their activities.

The next Swiss UNSGM Designated Laboratories Workshop organised by Spiez Laboratory has been scheduled for 9 to 11 September 2026.

10th Anniversary Excursion



Group Photo


Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra
UNSGM Designated Laboratories Workshop
9 - 11 September 2025, Spiez, Switzerland