Challenge 1: Screening Tools– an example scenario

Context: A sample is submitted to an analytical laboratory or collected when on operations. In either scenario the sample is required to be screened for the presence of materials of concern (i.e. hazardous to health) in order to inform subsequent decision making around triage, safe handling / sub-sampling and downstream analysis.

The screening tool might be able to, for example (not an exhaustive list):

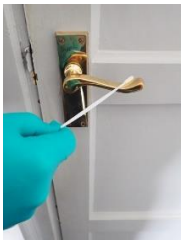
- determine with a high level of confidence whether the content of a sample is biological or chemical in nature
- provide an indication of the likely properties of the hazard (e.g. based on its physical or chemical composition)
- provide evidence of the nature, form or type of toxicity of the hazardous material based on the substance chemical properties (e.g. physical composition) or through its biological properties (e.g. binding to or acting on a specific type of receptor, cell, ion channel etc.)

Ultimately, a solution needs to be able to screen for a much broader range of materials than traditional detection tools that rely heavily on identification libraries of known materials / samples, or that specifically 'look for one class of agent' (e.g. only nerve agents, toxins, virus etc).

Challenge 2: Collection Systems – an example scenario

Context: A variety of different collection devices (e.g. swabs) can be used by deployed military staff and / or first responders to lift samples from surfaces. This apparently simple task, which can be much trickier when wearing Personal Protective Equipment (PPE), determines the amount and quality of sample that is subsequently made available for analysis either in the field or in an established analytical laboratory. For the purposes of this challenge a swab on its own is not considered a collection system as it makes no attempt to stabilise the material that has been extracted from a surface (see examples pictured).

Example A:
A collection device offering no sample protection **would not** be of interest. ✗



Example B:
A 'collection system' where the sample is stored within a stabilisation buffer **would be** of interest. ✔

The collection system might be able to, for example (not an exhaustive list):

- **must** be effective at lifting wet and / or dry samples from surfaces
- **must** offer some level of protection to the sample from the environment (without a cold chain storage requirement)
- could be more than one system which is designed or optimised to specifically stabilise biological or chemical or protein or biomedical samples
- might involve the use of a commercial-off-the-shelf device (e.g. swab) that is then immersed into a substance the preserves the integrity of the collected samples creating a new collection system (i.e. modified-off-the-shelf)
- could provide new sample collection technologies with combined sample preservation techniques.

Challenge 3: Forensic Exploitation – an example scenario

Context: Defence and Security Stakeholders are interested in establishing an increasing amount of information from samples submitted to the laboratory for analysis; particularly around a materials provenance, route of production or signatures of the individual that made the hazardous substance. Linking to or identifying the individual from the material under investigation will aid in a bringing of the perpetrator to justice and can act as an effective deterrent for the production or nefarious use of hazardous biological or chemical materials.

Forensic exploitation might be able to, for example:

- link (e.g. through the material properties, characteristics, contaminants) a sample from a ChemBio incident with another sample taken from the site of production (i.e. an improvised laboratory)
- analysing the composition of the whole sample, provide information of the route of its production or how it might have been stored (e.g. approaches that analyse the background materials, not just identify the hazardous material of concern)

It is likely that other sectors have approaches that can be repurposed to achieve more detailed or more sensitive forensic analysis. Parallels exist here with the verification of authenticity and provenance, e.g. of foodstuffs from particular regions of the world or of high value items (e.g. art, aerospace materials).