Forensic Super Sleuth

Text and Photo Sheilah Hamilton

Toxicology goes to school

In the last edition of *Culture*, we considered some of the ways that forensic toxicology appeared regularly in the lives of people who never really gave the subject a second thought. After all, I doubt if your average punter at Happy Valley or Shatin knew that his favourite horse was tested after each race meet to ensure that the animal had not been given some substance to make it perform better. People who think about forensic toxicology at all are more likely to be familiar with its use in connection with accidents caused by drunk driving, or where the driver was perfectly sober but the pedestrian, having consumed too many beers, had wandered erratically into the road. Even hardened forensic practitioners will be the first to admit that this particular subfield does not exactly lend itself to the TV screen, and might almost be considered the Cinderella of the discipline. Although it often requires sophisticated and expensive instrumentation to determine what had been swallowed, injected or otherwise applied to humans and other species, toxicology rarely lends itself to the use of the high power microscopes that produce the impressive images found during the examination of exotic pollen grains or the striation marks deposited on bullets exiting the barrel of a gun.

Nevertheless, forensic toxicology, at least in the form of the voluntary drug screen scheme to be introduced in early 2010 in some Government schools in the New Territories, is now very definitely on Hong Kong's agenda. At the time of writing, this trial scheme continues to attract considerable controversy, not because of concerns about the accuracy of the results but because of misgivings as to the effectiveness of any scheme where the possible participants can either elect to take part or abstain. However, since *Culture* is not the place to debate the possible inadequacies of such schemes, your resident *Supersleuth* will confine herself to discussing, in broad terms, this aspect of toxicology that relies primarily on the use of commercially available kits and not laboratory analysis. Indeed, some scientists may contend that using kits is not real toxicology. Others will hold the opposite view: that qualified toxicologists will have spent many months, sometimes years, working on these kits before they would have been passed for use in the field.

In the last article we saw that, when dealing with alcohol determination in live humans, two main fluids (blood and urine) are normally used, with breath being a third medium. We also noted that, for the most part, results from blood tended to be more accurate than those obtained from urine, but that drawing the sample of blood to be tested was very definitely an invasive procedure. Another important fact, with cost and other implications, was that medically qualified staff needed to collect blood whereas these same professionals were not necessary for urine collection. With these factors in mind, it may be useful to review some of the different methods that are available to test whether people have been using recreational drugs, and we will see that, as with most things in life, there are pros and cons.

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It makes sense to start by considering the procedures to be used in Hong Kong schools. According to information available from Hong Kong SAR Government sources, the screening process will involve a urine sample being provided by each volunteer, with aliquots of this fluid being applied by trained personnel to a single test kit containing mixtures of reagents designed to detect the presence of five different substances considered to be 'problem' drugs in Hong Kong. If a negative result is obtained in each of the five segments, no further action will be taken. However, if one or more of the results appears to be positive, further testing will follow because of the possibility of a false positive. As the name implies, a *false positive* occurs when the tested urine sample does *not* contain any of the targeted substances but the visual result suggests otherwise. For obvious commercial reasons, manufacturers of these kits go to great lengths to ensure that no erroneous results *should* occur. This is because no reputable client organization will use products with dubious pedigrees. However, despite the best efforts of companies producing the kits, false positives sometimes arise because human beings can, and do, ingest strange but perfectly legal things. There are also other reasons for the existence of false positives.

The important thing to appreciate is that after any apparently positive result is found, further testing will follow, and this will be performed in a laboratory. Here kits will rarely be used, unless the formers' accuracy is to be tested. The additional screening tests in the lab will use the same high-tech instruments employed in connection with individuals who are thought to have succumbed to a drugs overdose. And, of course, personnel trained in the application of toxicological methods will do this work.

Cost and convenience are some of the many concerns when considering which method should be used to test young people for possible substance abuse. In some jurisdictions, the kits used to test samples collected at schools are referred to as "Point of Collection Testing" (POCT) devices, and these have been contrasted with laboratory analysis.[1] Both methods have their good points as well as their limitations. The advantages of the POCT approach are that the devices are less expensive than laboratory testing, relatively simple to apply, and the tests are usually completed in a few minutes. Disadvantages include, but are not limited to, less accuracy, limitations in the drugs that can be detected, and the crucial fact that the procedure does not routinely allow for a permanent record of the visual results (unless, for example, a photograph is taken of the plate). On the other hand, when considering laboratory testing, the main drawback is that it is generally more expensive with slower turnaround times and obvious chain-of-custody implications.

Whilst urine samples are relatively easy to collect, there are challenges. Not only must any scheme be as tamperproof as possible, privacy issues must be respected. As a medium for analysis, it also suffers from the fact that it does not retain most drugs for as long as other bodily materials such as blood, sweat, hair and saliva.

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[1] "Drug testing in schools: evidence, impacts and alternatives", a paper by the Australian National Council on Drugs, 2007.

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However, we have already noted that drawing blood is definitely an invasive process, and certainly not one that is suitable for routine testing of school children.[2]

So, what else do we humans produce that might be useful for testing?

Well, saliva is one. This fluid is normally easy to collect, and drugs that have been ingested recently by the donor should be detectible since the drugs are present in higher concentrations that in urine. Another 'plus' is that it does not suffer from the same difficulties as some other bodily fluids since its collection is more easily supervised. However, on the down side, what has been described as the "window of detection" is shorter than other test types. Thus, if someone had consumed one of the targeted substances 12-24 hours before testing, it might no longer be present in saliva. And, since the food and drink that the subjects consumed may have an effect on the test results, students would need to be monitored for up to half an hour before the samples were donated.[1] It seems that no single medium is without its challenges!

Then again, most of us sweat, particularly in Hong Kong's summer months. Could perspiration be used? Its collection is certainly non-invasive. Whilst research has shown sweat patches to be very successful, both for monitoring a subject over a long period as well as single episodes, this has yet to be turned into viable commercial kits. Probably the best that can be said is: "Watch this space."

This leads us to our crowning glory – our hair. *Culture* readers with a historical bent will recall the story of Napoleon's hair and the arsenic that was thought to have killed him. However, hair can also retain less dramatic residues. Drug testing of individuals using their hair is not new, and is already the norm is some schools in Hong Kong.[3] It also has a long history in the UK where the Social Services and Courts use this method to determine whether parents of children at risk have stopped "using". The approximate rate of head hair growth is also well known. Thus, by cutting small lengths of hair close to the scalp and having them analysed, it can be shown whether the owner had been consuming some prohibited substance. Most people will not consider this process to be particularly invasive, it does not leave bruises nor does it cause undue embarrassment since usually only hairstylists will notice the missing tuft of hair. But what are the limitations of the method? One is that it is not suitable for monitoring recently ingested drugs, simply because hair does not sprout overnight like cress seeds. Hair analysis is definitely not the kind of test that can be done at the point of collection – a sophisticated laboratory is a must, and this has cost implications. What is more, researchers have found that some hair treatments may cause problems. And, if someone really wanted to opt out of the test, they could simply shave their hair. But then, in a *voluntary* scheme, they could just opt out – without losing their hair!

Readers will have seen from this article that toxicology is not without its difficulties when applied to drug testing in live people, particularly youngsters attending school. However, as was clear from the recent Michael Jackson case, forensic toxicology also plays a vital role when trying to piece together an individual's final hours. Additionally, the information that forensic toxicology provides in some fatal fires can be crucial, even showing that a victim did not succumb to smoke and toxic gases. The next *Supersleuthing* article in this series will concentrate on this thought provoking aspect of the subject, and discuss how toxicology results can be pivotal in determining whether individuals met their fate due to the fires themselves or whether their demise was caused by something much more sinister. C

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[2] An essay entitled "Why blood is not a suitable medium for routine drug testing in schools" could take several thousand words to complete!

[3] On 16 December 2009, scientists at the Hong Kong University of Science and Technology released important information about drug tests on 5-10 strands of hair being able to be completed in half a day. The hair-based drug testing technology developed by HKUST claimed to be able to trace a person's drug-taking history over the past 3 months or more – in terms of what drugs have been taken, when, and the actual dosage. http://www.ust.hk/eng/news/press_20091216-732.html