Case History

High-Performance Gold Standard Toxicology Lab in just 4 months

An interview with Dr Ben Davies of Healthscope Pathology on starting a NATA lab to serve the communities in South Australia

For two years years, toxicology tests from Healthscope Pathology's South Australian headquarters in Wayville, were sent over 700 kilometres away to the Healthscope Pathology laboratory in Clayton, Victoria, adding critical time to a crucial testing processes.

But not Anymore

On 15 January, 2013, the new Healthscope Pathology toxicology laboratory in Wayville received written confirmation that it had met the exacting, stringent standards set out by National Association of Testing Authorities (NATA).

The standard ensures that the detection of drugs of abuse in urine meets the expectations for testing specimens for medico-legal, workplace or court-directed purposes. It also sets out appropriate procedures for the collection of urine, on-site screening, handling and dispatch of specimens to the laboratory for screening and confirmatory tests.

Dr Davies is the toxicologist for Healthscope Pathology in South Australia who set up this lab. He joined Healthscope in April 2012 and was tasked to establish an accredited laboratory that would be able to undertake confirmatory testing by mass spectroscopy of urine specimens returning positive screening results.

His education and experience in analytical toxicology, such as peer reviewed publications and court testimony and, particularly, the analysis of biological materials for drugs of abuse, qualified him to manage the toxicology laboratory accredited by NATA to the Australian and New Zealand Standard (AS/NZS) 4308:2008, procedures for specimen and collection and the detection and quantitation of drugs of abuse in urine.

Fast, Strong and Kind on the Pocket

"My job was to develop the fastest and most robust methods for the confirmation by mass spectroscopy of all the analytes in urine of the five drug classes of AS/NZS 4308:2008 with the least expense, with respect to start-up and on-going costs," he explained.

A tall order? Not to Dr Davies. Time was of the essence as Healthscope Pathology's commercial clients, especially those in the mining industry, in South Australia needed a fully accredited laboratory for workplace urine drug testing. They wanted test results within the same day, at lowest possible costs, as it is expensive to stand down employees on full pay while waiting for laboratory confirmatory testing. "A day's pay is typically more than the cost of the testing," he continued.

"Purely commercial interests drove the entire project," Dr Davies said. He evaluated various solutions on the market and decided on a core group of vendors to be part of his extended project team. "This is all about management and knowing who to consult for expertise. I had bought GC/MS (gas chromatography-mass spectrometry) instruments from Agilent before, and each time, I had asked their specialists to specify and programme the analyser. Each GC/MS installation has been an evolution of the previous one, taking advantage of their innovative technology."

The Power to Simplify

Healthscope Pathology placed the order for the Agilent 7000B Quadrupole GC/MS/MS (gas chromatograph/tandem mass spectrometer), the most powerful trace detector for target analysis in complex matrices. The instrument raises the standard for robust GC/MS/MS operation while offering increased selectivity and sensitivity, and also simplified sample preparation, shortened analysis cycle times, eliminated false results and simplified data review for improved productivity.

Agilent was able to deliver and install the quadrupole MS/MS with custom GC in September 2012, within weeks of Dr Davies placing the order. Once operational it took less than a month with one of Agilent's application chemists to develop the methods on the analyser. "From this point the laboratory supervisor and I were able to validate all the methods, including sample preparation, within two months and in time for the NATA audit," he said.

Agilent 7890A GC equipped with automatic liquid sampler

The Agilent 7000B Quadrupole GC/MS/MS is supported by MassHunter software, which means that lab users can easily manage the entire system and analysis process – from intuitive, yet powerful instrument control and data acquisition, to qualitative and quantitative data analysis, and reporting.

As a user, Dr Davies identified a design detail that worked really well for him. The Agilent 7000B Quadrupole GC/MS/MS instrument's 7890A GC with 240 volt 16 amp fast oven option, the inlet and MSD interface are located in the rear positions to allow use of the oven insert accessory. "This significantly increases the temperature programming rates and dramatically shortens analysis time without having to use narrow bore capillary columns."

Additionally, an auxiliary pneumatic control module and purged union permit post-run back flushing of the analytical column. This shortened run times and had the ability to extend column life and prolong the service interval of the ion source.

No Mistakes

"In our work, accuracy and data integrity are important. We need to ensure that sample identities are not compromised. The instrument's autoinjector and sample tray have the capacity for 150 samples as well as handle sample overlap so that the syringe can be rinsed and then primed with the next sample while the previous analysis is still being performed."

The sample barcode reader was installed to verify the identity of each sample prior to injection. Bidirectional interfacing of the Mass Hunter software with the laboratory information management system had simplified import of the sequences and export of the results. This saved time and eliminated human error. "We cannot afford mistakes in workplace drug testing," said Dr Davies.

Dr Ben Davies in the Toxicology Laboratory at Wayville in South Australia

The toxicology lab in progress

Gold Standard For The Community

"At this lab we're achieving a throughput of 15 to 20 specimens per hour using the Agilent instrument, faster than comparable gas chromatography triple-quadrupole mass spectrometry systems. Additionally, we're saving with the fast uptime as the analyser is simple to set up and operate and it just keeps running," said Dr Davies. "We will release results within a day of a specimen arriving in the laboratory. And if any client wants a specimen tested for workplace, for court or child custody for instance, we're the only people here who can give you the full Standard."

Following the successful accreditation of the laboratory, Dr Davies has now begun developing assays for confirmatory testing of drugs in oral fluid to the Australian Standard 4760:2006.

Since 1936, Healthscope has been serving communities in South Australia. Today, Healthscope Pathology, employing over 500 staff, comprises 8 National Association of Testing Authorities (NATA) accredited laboratories across Australia. It is the leading pathology provider, operating over 500 Accredited Collection Centres (ACCs). Outside of Australia, Healthscope Pathology is largest pathology provider in New Zealand servicing over 50% of the country's population, occupies the number one market position in Singapore with 40% share of the community pathology market and operates the largest network across the Malaysian peninsula, Borneo and Brunei.

A report from the Mine Substance Abuse Task Force in the United States published in late 2005 [1] highlighted substance abuse in the mining industry. It has been suggested that drug dependency can develop from legitimate use of prescribed painkillers to treat chronic illness. Among the substances are alcohol, Amphetamines (including methamphetamines), Barbiturates, Benzodiazepines (such as Valium, Librium, Xanax), Cannabinoids (marijuana/tetrahydrocannabinol), Cocaine, Methadone, Opiates (such as heroin, opium, codeine, morphine), Phencyclidine (PCP), Propoxyphene (such as Darvon), and Synthetic/Semi-synthetic opioids (including hydrocodone, hydromorphone, oxymorphone and oxycodone).

In Australia, there have been media reports of use of drugs in mining sites, particularly synthetic drugs with street names such as Venom and Kronic [2]. In a 2012 report, on average, Kronic was used on average by 10% of miners, and up to as much as 30% at some mines [3].

Although specific studies are not available, there have been mentions of alcoholism and drug abuse in mines in Indonesia in a 2000 discussion paper by the Environment and Social Development Unit (EASES), East Asia and Pacific Region of the World Bank [4].

The misuse of alcohol and drugs pose a threat to the safety, health and well-being [5] of all miners as substance abuse have an impact on an individual's physical, emotional and behavioural well-being. Examples of such instances include mishaps such as careless actions in the operation and maintenance of potentially hazardous materials or dangerous equipment, a lack of attention to detail on performing routine job duties or being argumentative or unresponsive instead of following instructions at work. With safety as a paramount concern, employers are turning to education as well as screening programmes to try to maintain an alcohol- and drug-free working environment.

References

1 *Mine Substance Abuse Task Force Final Report, December 2005 http://dnr.ky.gov/DNR%20Documents/Mining%20Reports/TaskForceFinalReport129.pdf*

2 *Australian Mining article http://www.miningaustralia.com.au/news/mine-workers-chase-new-legal-highs*

3 *Australian Mining article http://www.miningaustralia.com.au/news/one-in-ten-miners-on-legal-drugs*

4 *Titled Mining and the Environment in Indonesia: Long-term Trends and Repercussions of the Asian Economic Crisis published in November 2000. http://commdev.org/files/877_file_mining_and_the_environment.pdf*

5 *From a template provided by the United State's Mine Safety and Health Administration http://www.msha.gov/DrugFree/Alcohol%20and%20Drug%20Free%20Mines%20Sample%20Policy%20and%20Training%20Materials.pdf*