

# MATRIX Drugs of Abuse/Alcohol Key Cup

Plus Optional Adulterant Strip(s)

## FOR THE QUALITATIVE ASSESSMENT OF DRUGS AND/OR THEIR METABOLITES IN HUMAN URINE

and

### URINE ALCOHOL (Optional)

## FOR THE SEMI-QUANTITATIVE ASSESSMENT OF ETHYL ALCOHOL IN HUMAN URINE

Plus

### URINE CHECK (Optional)

## FOR THE VALIDATION OF URINE SPECIMEN EXAMINED

### For in vitro Diagnostic and Forensic Use



### Optional: Alcohol & Adulteration

The Matrix Key Cup can be customised to include the following adulteration parameters if required - Creatinine, pH, Specific Gravity, Nitrite, Oxidant, Glutaraldehyde, Bleach, and Pyridinium Chlorochromate. A urine alcohol strip can also be included if required.

### INTENDED USE

The Matrix Key Cup Durgs of Abuse/Alcohol Test Cup ,hereinafter referred to as Martix Key Cup,is an immunochromatography based One step in vitro test.It is designed for qualitative determination of drug substances in human urine specimens.This assay may be used in the point of care setting.Below is a list of cut-off concentrations for each drug.

Amphetamine	1000 ng/ml of d-amphetamine
Barbiturate	300 ng/ml of secobarbital
Benzodiazepine	300 ng/ml of oxazepam
Buprenorphine	10 ng/ml of Buprenorphine-3-β-d-glucuronide
Cocaine	300 ng/ml of benzoylecgonine
EDDP	100 ng/ml of EDDP
Ketamine	1000 ng/ml of Ketamine
Methadone	300 ng/ml of methadone
Methamphetamine ( includes Ecstasy)	1000 ng/ml of (+)methamphetamine
MDMA (Ecstasy specific)	500 ng/ml of MDMA
Opiate*	300 ng/ml of morphine
Opiate II*	2000 ng/ml of morphine
Oxycodone	100 ng/ml of oxycodone
Phencyclidine	25 ng/ml of phencyclidine
Cannabinoid (THC)	50 ng/ml of 11-nor-Δ <sup>9</sup> -THC-9-COOH
Propoxyphene	300 ng/ml of Norpropoxyphene
Tramadol	200 ng/ml of Tramadol
Tricyclic antidepressant (TCA)	1000 ng/ml of Nortriptyline
6-MAM	10 ng/ml of 6-Acetylmorphine
ZOL	50 ng/ml of Zolpidem Phenyl-4-carboxylic acid
LSD	20 ng/ml of Lysergic acid diethylamide
7-ACL	300 ng/ml of 7-Aminoclonazepam
PGB	500 ng/ml of Pregabalin
MES	300 ng/ml of Mescaline
MDPV	500 ng/ml of 3,4-Methylenedioxypropylvalerone
MCAT	500 ng/ml of Methcathinone
MEP	500 ng/ml of Mephedrone
GAB	2000 ng/ml of Gabapentin
ETG	500 ng/ml of Ethyl Glucuronide
ETG II*	1000 ng/ml of Ethyl Glucuronide
CFYL	500 ng/ml of Carfentanil
K2-AB	25 ng/ml of AB-PINACA
CAF	8000 ng/ml of Caffeine
K2	50 ng/ml of JHW-018 and JWH-073
FYL	10 ng/ml of Fentanyl

COT	200 ng/ml of Cotinine
MQL	300 ng/ml Methaqualone
Alcohol	40 mg/dl (0.04% BAC) of Alcohol
Oxidants/ Specific Gravity / pH/Nitrite / Glutaraldehyde/Creatinine	

This assay provides a preliminary analytical test result. A more specific alternative chemical method must be used in order to obtain a confirmed analytical result. Gas chromatography/ mass spectrometry (GC/MS) has been established as the preferred confirmatory method by the Substance Abuse Mental Health Services Administration (SAMHSA). Clinical consideration and professional judgment should be applied to any drugs of abuse test result, particularly when preliminary positive results are indicated. The optional built-in Adulteration Test is for validation of urine specimen's integrity and must not be used for In Vitro diagnostic use.

\* **SAMHSA recommends a cut-off concentration of 2000 ng/ml for Opiates Test**

### SUMMARY AND EXPLANATION

#### Drugs of Abuse

**Amphetamines** are a class of potent sympathomimetic agents with therapeutic applications. The most common amphetamines are d-amphetamine and d,l-amphetamine. Amphetamines are central nervous stimulants that cause the neurotransmitters epinephrine, norepinephrine and dopamine to be released into the brain and body giving users feelings of euphoria, alertness, and increased energy. Chronic abuse of amphetamine leads to tolerance and drug reinforcement effect. Cardiovascular responses to amphetamine include increased blood pressure and cardiac arrhythmias. More acute responses produce anxiety, paranoia, hallucinations and psychotic behavior. Amphetamine is metabolised by a number of pathways. In general, acid urine promotes excretion whereas alkaline urine retards it. In 24 hours, approximately 79% of the amphetamine dose is excreted in acid urine and about 45% in alkaline urine. Typically, about 20% is excreted as unchanged amphetamine. Unchanged amphetamine can be detected up to 1–2 days after use.

**Barbiturates** are a group of prescription drugs that are frequently abused. They can depress the central nervous system. Acute higher dose induces exhilaration, sedation and respiratory depression. More acute responses produce respiratory collapse and coma. The effects of short-acting barbiturates, such as secobarbital last 3 to 6 hours. The effects of long-acting barbiturates such as phenobarbital last 10 to 20 hours. Short-acting barbiturates normally remain detectable in urine for 4 to 6 days, while long-acting barbiturates can be detected for up to 30 days. Barbiturates are excreted in the urine in unchanged forms, hydroxylated derivatives, carboxylated derivatives and glucuronide conjugates.

**Benzodiazepines** are a class of widely prescribed central nervous system depressants which have anxiolytic, hypnotic, anticonvulsant and muscle relaxant effects. Chronic abuse can result in addiction and tardive dyskinesia. Acute higher doses lead to drowsiness, dizziness, muscle relaxation, lethargy, coma and possible death. The effects of benzodiazepines use last 4 – 8 hours. Many of the benzodiazepines share a commonmetabolic route, and are excreted as oxazepam and its glucuronide in urine. Oxazepam is detectable in the urine for up to 7 days after drug use.

**Buprenorphine** a derivative of thebaine, is an opiate that has been marketed in the United States as a Schedule V parenteral analgesic Buprenex. In 2003, based on a reevaluation of available evidence regarding the potential for abuse, addiction, and side effects, the DEA reclassified buprenorphine from a Schedule V to a Schedule III narcotic. Buprenorphine and bupine resembles morphine structurally but has a longer duration of action than morphine and can be administered sublingually as an analgesic. In October 2002, the FDA approved the use of a buprenorphine monotherapy product, Subutex, and a buprenorphine/naloxone combination product, Suboxone, for the treatment of opioid addiction. Subutex and Suboxone are the first narcotic drugs available under the US Drug Act (DATA) of 2003 for the treatment of opiate dependence that can be prescribed in the US in a physician's work place. It has also been shown that buprenorphine has abuse potential and may itself cause dependency. In addition, a number of deaths have been recorded as a result of overdose with intravenously injected buprenorphine in conjunction with other psychotropic drugs such as benzodiazepines. Buprenorphine is metabolised primarily by n-dealkylation to form glucuronide-buprenorphine and glucuronide-norbuprenorphine.

**Cocaine** Derived from the leaves of the coca plant, cocaine is a potent central nervous system stimulant as well as a local anesthetic. Some of the psychological effects induced by cocaine are: euphoria, confidence and a sense of increased energy accompanied by increased heart rate, dilation of the pupils, fever, tremors and sweating. Continued ingestion of cocaine could induce tolerances and physiological dependency which leads to its abuse. Cocaine is used by smoking, intravenous, intranasal or oral administration and excreted in the urine primarily as benzoylecgonine in a short period. Benzoylecgonine has a biological half-life of 5 – 8 hours, which is much longer than that of cocaine (0.5 – 1.5 hours), and can be generally detected for 12 – 72 hours after cocaine use or exposure.

**EDDP** 2-Ethylidene-1,5-dimethyl-3,3-diphenylpyrrolidine, is the primary metabolite of methadone. Methadone is a controlled substance and is used for detoxification and maintenance of opiate dependant patients. Patients on methadone maintenance may exhibit methadone (parent) levels that account for 5-50% of the dosage and 3-25% of EDDP in urinary excretion during the first 24 hours. The detection of EDDP is more beneficial than traditional methadone screening, in that EDDP exists only in urine from individuals that have ingested methadone. The tampering of specimens by spiking the urine with methadone can be prevented. Secondly, renal clearance of EDDP is not affected by urinary pH, therefore the EDDP test provides a more accurate result of methadone ingestion than the methadone parent screen.

**Methadone** is a synthetic opioid, clinically available. It is used clinically for the treatment of severe pain and in maintenance programs for morphine and heroin addicts. Methadone acts on the central nervous and cardiovascular systems to produce respiratory and circulatory depression. Methadone also produces miosis and increases the tone of smooth muscle in the lower gastrointestinal tract while decreasing the amplitude of contractions. Acute higher doses induce analgesia, sedation, respiratory depression and coma. After methadone administration, the major urinary excretion products are methadone and its metabolites, EDDP and EMPDP. Large individual variations in the urine excretion of methadone are output of methadone from 5-22%. Typically, following a 5 mg oral dose, methadone and EDDP account for 5% of the dose in the 24-hour urine. In those individuals on maintenance therapy, methadone may account for 5 to 50% of the dose in the 24-hour urine and EDDP may account for 3 to 25% of the dose.

**Methamphetamine** is the most popular synthetic derivative of the amphetamines. It is a potent sympathomimetic agent with therapeutic applications. Acute large doses lead to enhanced stimulation of the central nervous system and induce euphoria, alertness, reduced appetite, and a sense of increased energy and power. More acute response produces anxiety, paranoia, psychotic behavior, and cardiac dysrhythmias. Methamphetamine is excreted in the urine as amphetamine and oxidised and de-aminated derivatives. However, 10-40% of methamphetamine is excreted unchanged. Methamphetamine is generally detectable in the urine for 3 to 5 days after use.

**MDMA** Methylenedioxyamphetamin (Ecstasy) is a designer drug first synthesised in 1914 by a German drug company for the treatment of obesity. Those who take the drug frequently report adverse effects, such as increased muscle tension and sweating. MDMA is not clearly a stimulant, although it has, in common with amphetamine drugs, a capacity to increase blood pressure and heart rate. MDMA does produce some perceptual changes in the form of increased sensitivity to light, difficulty in focusing, and blurred vision in some users. Its mechanism of action is thought to be via release of the neurotransmitter serotonin. MDMA may also release dopamine, although the general opinion is that this is a secondary effect of the drug. The most pervasive effect of MDMA occurring in almost all people who have taken a reasonable dose of the drug, is to produce a clenching of the jaws. The MDMA Ecstasy Test Strip yields a positive result when Methylenedioxyamphetamin in urine exceeds 500ng/ml.

**Ketamine** is a derivative of phencyclidine. It is used medically as a veterinary and human anaesthetic. Certain doses of ketamine can cause dream-like states and hallucinations. In high doses, ketamine can cause delirium, amnesia, impaired motor function, high blood pressure, depression, and potentially fatal respiratory problems. Ketamine is metabolised in the liver and excreted through the kidney. The half-life of ketamine in the body is around three hours.

**Opiate** Opioid analgesics comprise of a large group of substances that control pain by depressing the central nervous system. Acute high dose used by abusers or addicts can cause depressed coordination, disrupted decision, decreased respiration, hypothermia and coma. Morphine is excreted unmetabolised and is the marker metabolic product of opiates. Morphine and morphine glucuronide is detectable in urine for several days after an opiate dose.

**Oxycodone** is known as Oxycontin, Roxicodone and is an ingredient of Percodan, Percocet, Roxicet and Tylox. Oxycodone is a semi-synthetic opiate derived from opium. Like other opiates, oxycodone is characterised by its analgesic properties, and the tendency for users to form a physical dependency and develop tolerance with extended use. Oxycodone is usually administered in combination with non-opiate analgesics such as acetaminophen and salicylates for the relief of moderate to severe pain. Oxycodone is a central nervous system depressant that may cause drowsiness, dizziness, lethargy, weakness and confusion. Toxicity in an overdose of oxycodone can and lead to stupor, coma, muscle flaccidity, severe respiratory depression, hypotension, and striptic arrest. Oxycodone is metabolised by N- and O-demethylation. One of the metabolites, oxymorphone, is a potent narcotic analgesic, while the other, noroxycodone, is relatively inactive. Between 33 to 61% of a single dose of oxycodone is excreted in a 24 hour urine collection and consists of 13-19% free oxycodone, 7-29% glucuronide conjugated oxycodone, 13-14% glucuronide conjugated oxymorphone and an unknown amount of noroxycodone. The detection time window of oxycodone is 1-3 days following use.

**Phencyclidine** commonly known as PCP, is a hallucinogen which interacts with dopamine, cholinergic and adrenergic systems. It has dose dependent stimulant, depressant, hallucinogenic and psychological effects. PCP is mostly administered orally or intravenously. Even a moderate amount of PCP, from 5 to 100 ng/ml, can result in psychotic, violent and self-destruction. At high doses, from 100 to 500 ng/ml, PCP can cause convulsions, hypertion, prolonged coma, absent peripheral sensation, and even death. PCP is metabolised via hydroxylation,

oxidation, and conjugation with glucuronic acid in the liver. About 10% of the dose is excreted in urine as unchanged drug. For chronic users, PCP can be detected in the urine for 7 to 8 days after drug administration.

**Propoxyphene** Propoxyphene is a prescription drug for the relief of pain. Although slightly less selective than morphine, Propoxyphene binds primarily to opioid receptors and produces analgesia and other CNS effects that are similar to those seen with morphine-like opioids. It is likely that at equianalgesic doses the incidence of side effects such as nausea, anorexia, constipation, abdominal pain and drowsiness are similar to those of codeine. After oral administration, concentrations of Propoxyphene in plasma reach their highest values at 1 to 2 hours. There is great variability between subjects in the rate of clearance and the plasma concentrations that are achieved. The percentage of excreted unchanged Propoxyphene in urine is less than 1%. In humans, the major route of metabolism is N-demethylation to yield norpropoxyphene. Norpropoxyphene has a longer half-life (30 to 36 hours) than parent Propoxyphene (6 to 12 hours), and its accumulation with repeated doses may be responsible for some of the observed toxicity.

**THC** The agents of Marijuana that cause various biological effects in humans are called cannabinoids. Cannabinoid is a central nervous stimulant that alters mood and sensory perceptions, produces loss of coordination, impairs short term memory, and produces symptoms of anxiety, paranoia, depression, confusion, hallucination, and increased heart rate. Large doses of cannabinoids could cause the development of tolerances and physiological dependency and lead to abuse. A tolerance to the cardiac and psychotropic effects can occur and withdrawal syndrome produces restlessness, insomnia, anorexia and nausea. Δ<sup>9</sup>-THC is the primary active ingredient in cannabinoids. The main metabolite excreted in the urine is 11-nor-Δ<sup>9</sup>-THC-9-COOH, which are found within hours of exposure and remain detectable in the urine for 3-10 days after smoking.

**Tramadol** is a quasi-narcotic analgesic used in the treatment of moderate to severe pain. It is a synthetic analog of codeine, but has a low binding affinity to the mu-opioid receptors. Large doses of tramadol can develop tolerance and physiological dependency and lead to its abuse. Tramadol is extensively metabolised after oral administration. Approximately 30% of the dose is excreted in the urine as unchanged drug, whereas 60% is excreted as metabolites. The major pathways appear to be N- and O- demethylation, glucuronidation or sulfation in the liver.

**TCA** Tricyclic antidepressants, commonly known as TCA, are a group of antidepressant drugs. TCA are mostly administered by oral or intramuscularly. The progressive symptomatology of TCA includes agitation, confusion, hallucinations, hypertonicity, seizures and EKG changes. Nortriptyline, Desipramine (Protopran) and Imipramine (Tofranil) are the most often used TCA. TCA's half life varies from a few hours to a few days. TCA's are excreted with less than 1% of the unchanged drug.

**6-MAM** 6-Monoacetylmorphine (6-MAM) or 6-acetylmorphine is one of three active metabolites of heroin (diacetylmorphine), the others being morphine and the much less active 3-monoacetylmorphine (3-MAM).6-MAM is rapidly created from heroin in the body, and then is either metabolized into morphine or excreted in the urine. Since 6-MAM is a unique metabolite to heroin, its presence in the urine confirms that heroin was the opioid used. This is significant because on a urine immunoassay drug screen, the test typically tests for morphine, which is a metabolite of a number of legal and illegal opiates/opioids such as codeine, morphine sulfate, and heroin. 6-MAM remains in the urine for no more than 24 hours so a urine specimen must be collected soon after the last heroin use, but the presence of 6-MAM guarantees that heroin was in fact used as recently as within the last day. 6-MAM is naturally found in the brain, but in such small quantities that detection of this compound in urine virtually guarantees that heroin has recently been consumed.

**ZOL** Zolpidem is a prescription medication used for the treatment of insomnia and some brain disorders. It is a short-acting nonbenzodiazepine hypnotic of the imidazopyridine class that potentiates GABA, an inhibitory neurotransmitter, by binding to GABA<sub>A</sub> receptors at the same location as benzodiazepines. It works quickly, usually within 15 minutes, and has a short half-life of two to three hours. Zolpidem has not adequately demonstrated effectiveness in maintaining sleep, unless delivered in a controlled-release (CR) form. However, it is effective in initiating sleep. Its hypnotic effects are similar to those of the benzodiazepine class of drugs, but it is molecularly distinct from the classical benzodiazepine molecule and is classified as an imidazopyridine. Flumazenil, a benzodiazepine receptor antagonist, which is used for benzodiazepine overdose, can also reverse zolpidem's sedative/hypnotic and memory-impairing effects.

**LSD** Lysergic acid diethylamide, abbreviated LSD or LSD-25, also known as lysergide and colloquially as acid, is a semisynthetic psychedelic drug of the ergoline family, well known for its psychological effects which can include altered thinking processes, closed and open eye visuals, synaesthesia, an altered sense of time and spiritual experiences, as well as for its key role in 1960s counterculture. It is used mainly as an entheogen, recreational drug, and as an agent in psychedelic therapy. LSD is non-addictive, is not known to cause brain damage, and has extremely low toxicity relative to dose, although in rare cases adverse psychiatric reactions such as anxiety or delusions are possible.

**7-ACL** 7-aminoclonazepam is the major metabolite of clonazepam. Clonazepam sold under the brandname Klonopin among others, is a medication used to prevent and treat seizures, panic disorder, and for the movement disorder known as akathisia. It is a type of benzodiazepine. As a major metabolite, 7-aminoclonazepam may be used to monitor use of the parent drug, clonazepam. Clonazepam, marketed as Klonopin and Rivotril, is a long-acting benzodiazepine with anxiolytic, anticonvulsant, muscle relaxant, and hypnotic properties.

**PGB** Pregabalin is a medication primarily used for epilepsy, neuropathic pain, and fibromyalgia. Its use for epilepsy is as an add-on therapy for partial seizures with or without secondary generalization in adults. It is also considered useful for generalized anxiety disorder.Pregabalin is a lipophilic structural analogue of γ-Aminobutyric acid (GABA) and classified as a depressant by the Drug Enforcement Agency. It is a neurotransmitter modulator that has analgesic, anticonvulsant, anxiolytic, and sleep-modulating properties.Pregabalin is a potent gabapentinoid and a close structural analogue of GABOB (β-(4-chlorophenyl)-GABA)and phenibut (β-phenyl-GABA). Common side effects include: sleepiness, confusion, trouble with memory, poor coordination, dry mouth, problem with vision, and weight gain. Potentially serious side effects include angoedema, drug misuse, and an increasedsuicide risk.

**MES** Mescaline or 3,4,5-trimethoxyphenethylamine is a naturally occurring psychedelic alkaloid of the phenethylamineclass, known for its hallucinogenic effects similar to those of LSD and psilocybin. It shares strong structural similarities with the catecholamine dopamine.It occurs naturally in the peyote cactus (Lophophora williamsii), the San Pedro cactus (Echinopsis pachanoi) and in the Peruvian torch (Echinopsis peruviana), and as well in a number of other members of the Cactaceae plant family. It is also found in small amounts in certain members of the Fabaceae (bean) family, including Acacia berlandieri. Tolerance builds with repeated usage, lasting for a few days. Mescaline causes cross-tolerance with other serotonergic psychedelics such as LSD andpsilocybin.About half the initial dosage is excreted after 6 hours, but some studies suggest that it is not metabolized at all before excretion. Mescaline appears to not be subject to metabolism by CYP2D6and between 20% and 50% of mescaline is excreted in the urine unchanged, and the rest being excreted as the carboxylic acid form of mescaline, a likely result of MAO degradation.

**MDPV** Methylenedioxypropylvalerone (MDPV) is a psychoactive drug with stimulant properties which acts as a norepinephrine-dopamine reuptake inhibitor. The primary psychological effects have a duration of roughly 3 to 4 hours, with after effects such as tachycardia, hypertension, and mild stimulation lasting from 6 to 8 hours.

**MCAT** Methcathinone, is a monoamine alkaloid and psychoactive stimulant, a substituted cathinone. Methcathinone is a highly addictive drug, primarily psychologically addicting and most of the signs of addiction to the drug are emotional or psychological. It has been popularized and continues to be sold under misleading names such as "bath salts", "plant fertilizers" or "research chemicals", but it is actually a powerful psycho-stimulant used as a recreational drug. Effects of this drug typically last from 4 to 6 hours. It is used as a recreational drug due to its potent stimulant and euphoric effects and is considered to be addictive, with both physical and psychological withdrawal occurring if its use is discontinued after prolonged or high-dosage administration . It is usually snorted, but can be smoked, injected, or taken orally. Methcathinone is listed as a Schedule I controlled substance by the Convention on Psychotropic Substances and the United States' Controlled Substances Act, and as such it is not considered to be safe or effective in the treatment, diagnosis, prevention, or cure of any disease, and has no approved medical use. Methcathinone has very strong affinities for the dopamine transporter and the norepinephrine (noradrenaline) transporter. Its affinity for the serotonin transporter is less than that of methamphetamine.

**MEP** Mephedrone, also known as 4-methylmethcathinone (4-MMC) or 4-methylpephedrone is a synthetic stimulant drug of the amphetamine and cathinone classes. Slang names include drone, M-CAT, White Magic and meow meow. It is chemically similar to the cathinone compounds found in the khat plant of eastern Africa. Mephedrone comes in the form of tablets or a powder, which users can swallow, snort or inject, producing similar effects to MDMA, amphetamines and cocaine. In addition to its stimulant effects, Mephedrone produces side effects, of which teeth grinding are the most common. A number of metabolites are possible, however the n-demethyl metabolite of Mephedrone will be 4-Methylcathinone. This metabolite appears to be nearly inactive as a Monoamine Oxydase Inhibitor. On further metabolism of this metabolite one of the possible metabolites is 4-Methylnorephedrine, caused by the reduction of the Keto.A dose of 150mg-250mg is the average, giving a duration of around 2 hours.the duration will lengthen in larger 250mg+ dosages.

**GAB** Gabapentin (GAB) marketed under the brand name Neurontin among others, is a medication used to treat epilepsy,neuropathic pain, hot flashes, and restless leg syndrome. In epilepsy it may be used for those with partial seizures. It is recommended as one of a number of first line medications for the treatment of neuropathic pain including neuropathy, post-herpetic neuralgia, and central neuropathic pain. The mechanism of the anticonvulsant action of gabapentin has not been fully described. Several possible mechanisms for pain improvement have been discussed. Though similar in structure to the endogenous neurotransmitter GABA, gabapentin has not been shown to bind to GABA receptors at concentrations at or below 1 mM. Gabapentin modulates the action of glutamate decarboxylase (GAD) and branched chain aminotransferase (BCAT), two enzymes involved in GABA biosynthesis. In human and rat studies, gabapentin was found to increase GABA biosynthesis, and to increase non-synaptic GABA neurotransmission in vitro.Common side effects include sleepiness and dizziness. Serious side effects may include an increased risk of suicide, aggressive behaviour, and drug reaction with eosinophilia and systemic symptoms. It is unclear if it is safe duringpregnancy or breastfeeding. Lower doses should be used in people with kidney problems. Gabapentin affects the inhibitory neurotransmitter γ-aminobutyric acid (GABA).

**CFYL** Carfentanil is an analog of the synthetic opioid analgesic fentanyl. It is 10,000 times more potent than morphine, making it among the

most potent commercially used opioids. Carfentanil was first synthesized in 1974. It is marketed under the trade name Wildnil as a general anaesthetic agent for large animals. Side effects of carfentanil are similar to those of fentanyl, which include itching, nausea and respiratory depression, which can be life-threatening. Carfentanil is classified as Schedule II under the Controlled Substances Act in the United States with a DEA ACSCN of 9743.

**K2-AB** AB-PINACA is a synthetic cannabinoid usually sold as a herbal smoking mixture designed to mimic THC, the active chemical of cannabis. Synthetic cannabinoids are classed as 'New Psychoactive Substances' (NPS) which are unregulated substances that have become newly available on the market as an alternative to illegal drugs. As a reaction to prohibition, synthetic cannabinoid producers change the compounds found in designer drugs and create new generations of synthetic drugs, such as AB-PINACA. As a result, accidental overdose and severe psychiatric complications may be more likely to occur because the type and amount of active compound may vary considerably from batch to batch. Other effects may include agitation, rapid heart rate, confusion, dizziness and nausea.

**CAF** Caffeine is a central nervous system (CNS) stimulant of the methylxanthine class. It is the world's most widely consumed psychoactive drug. It is found in the seeds, nuts, or leaves of a number of plants native to South America and East Asia and confers on them several survival and reproductive benefits. Caffeine can produce a mild form of drug dependence-associated with withdrawal symptoms such as sleepiness, headache, and irritability – when an individual stops using caffeine after repeated daily intake. After intravenous administration of caffeine the urine level of the drug is approximately the same in each of the first 4 hourly specimens. Blood samples taken 10 and 70 minutes after injection of the drug were analyzed and showed 0.29 and 0.28mg. per 100 cc. respectively. There are to be contrasted with the 1st hour urine which contained 0.73mg.per 100 cc., essentially 3 times that in the blood. After oral administration of caffeine to the horse the concentration of caffeine in the urine rose progressively during the first 3 hours, remained relatively constant through the 6th hours. At 48 hours, a urine specimen contained approximately 0.17mg. per 100 cc. of caffeine. In addition, flu-like symptoms, nausea/vomiting, and muscle pain/stiffness were judged likely to represent valid symptom categories. In experimental studies, the incidence of headache was 50% and the incidence of clinically significant distress or functional impairment was 13%. Typically, onset of symptoms occurred 12–24 h after abstinence, with peak intensity at 20–51 h, and for a duration of 2–9 days. 1% to 3% of caffeine is excreted unchanged in the urine. The rate of caffeine metabolism is variable, with a half-life of 4 to 6h.

**ETG** Ethyl glucuronide (ETG) is a minor non-oxidative metabolite of ethyl alcohol formed by the in vivo conjugation of ethanol with glucuronic acid with UDP glucuronosyl transferase.ETG is a product of metabolic process about of Ingested alcohol (ethanol) rapidly metabolized in the body, which is excreted in the blood, hair and urine. By using The ETG Rapid Test Device (Urine), can detect ETG in urine, confirming the consumption of alcohol. The ETG metabolite remains in the body longer and therefore has a more useful window of detection of 8 to 80 hours. ETG testing is an excellent option for zero-tolerance alcohol consumption or rehabilitation programs

**K2** Synthetic cannabis is a psychoactive designer drug derived from natural herbs sprayed with synthetic chemicals that, when consumed, allegedly mimic the effects of cannabis. It is best known by the brand names K2 and Spice, both of which have largely become genericized trademarks used to refer to any synthetic cannabis product. Studies suggest that synthetic cannabinoid intoxication is associated with acute psychosis, worsening of previously stable psychotic disorders, and also may have the ability to trigger a chronic (long-term) psychotic disorder among vulnerable individuals such as those with a family history of mental illness. When synthetic cannabis blends first went on sale in the early 2000s (decade), it was thought that they achieved an effect through a mixture of legal herbs. Laboratory analysis in 2008 showed that this is not the case, and that they in fact contain synthetic cannabinoids that act on the body in a similar way to cannabinoids naturally found in cannabis, such as THC. A large and complex variety of synthetic cannabinoids, most often cannabicyclohexanol, JWH-018, JWH-073, or HU-210, are used in an attempt to avoid the laws that make cannabis illegal, making synthetic cannabis a designer drug. It has been sold under various brand names, online, in head shops, and at some gas stations.

**COT** Cotinine is the first-stage metabolite of nicotine, a toxic alkaloid that produces stimulation of the autonomic ganglia and central nervous system when in humans. Nicotine is a drug to which virtually every member of a tobacco-smoking society is exposed whether through direct contact or second-hand inhalation. In addition to tobacco, nicotine is also commercially available as the active ingredient in smoking replacement therapies such as nicotine gum, transdermal patches and nasal sprays. In a 24-hour urine, approximately 5% of a nicotine dose is excreted as unchanged drug with 10% as cotinine and 35% as hydroxycotinine; the concentrations of other metabolites are believed to account for less than 5%. While cotinine is thought to be an inactive metabolite, its elimination profile is more stable than that of nicotine which is largely urine pH dependent. As a result, cotinine is considered a good biological marker for determining nicotine use. The plasma half-life of nicotine is approximately 60 minutes following inhalation or parenteral administration. Nicotine and cotinine are rapidly eliminated by the kidney; the window of detection for cotinine in urine at a cutoff level of 200 ng/mL is expected to be up to 2-3 days after nicotine use.

**FYL** Fentanyl is a synthetic opioid related to the phenylpiperidines.Fentanyl is approximately 100 times more potent than morphine. This agent is highly lipid soluble and rapidly cross the blood-brain barrier. This is reflected in the half-life for equilibration between the plasma and cerebrospinal fluid of approximately 5 minutes for fentanyl. The levels in plasma and cerebrospinal fluid decline rapidly owing to redistribution of fentanyl from highly perfused tissue groups to other tissues, such as muscle and fat. As saturation of less well-perfused tissues occurs, the duration of effect of fentanyl and sufentanil approaches the length of their elimination half-lives of between 3 and 4 hours. Fentanyl undergoes hepatic metabolism and renal excretion. Therefore, with the use of higher doses or prolonged infusions, fentanyl becomes longer acting.

**MQL** Methaqualone is classified as a sedative/hypnotic. It was originally synthesized in India to combat malaria but found to be ineffective. Methaqualone did prove effective as a sedative and was developed in the hopes of avoiding some of the adverse effects of the barbiturates, particularly their high capacity for addiction. Unfortunately, methaqualone was found to be just as addictive. Physiologically, methaqualone is cumulative, and tolerance occurs rapidly in some individuals. In addition, it is extensively metabolized,at least 12 hydroxylated metabolites having been identified in the urine. The major metabolites are methaqualone-N-oxide, conjugate 4'-hydroxy-methaqualone,conjugated 2'-hydroxymethaqualone.About 0.2% of methaqualone is excreted unchanged within 24 hours;40-50% of the methaqualone is excreted as metabolites within 72 hours,mostly as the glucuronide conjugates. The half-life for methaqualone averages 33 to 36 hours.It can be detected up to four days after administration.Side effects from chronic use of methaqualone are loss of motor coordination,walking into walls,ataxia,slurred speech,drowsiness and nystagmus.Severe acute overdose tends to produce muscle spasms, abnormally rapid reflexes,extreme muscle tension and restlessness.

**Alcohol** Acute alcohol intoxication can lead to loss of alertness, coma, and even death. Long term effects include internal organ damage and birth defects. The blood alcohol concentration (BAC) at which a person becomes impaired is variable. The United States Department of Transportation (DOT) has established a BAC of 0.02% (0.02g/dL) as the cut-off level at which an individual is considered positive for the presence of alcohol. Since urine alcohol concentration is normally higher than that in saliva and blood, the cutoff concentration for alcohol in urine is set at 0.04%.

#### UrineCheck: Adulteration Test(s)

UrineCheck adulteration tests are built-in firm plastic strips to which options of one (1) up to six (6) different reagent areas can be affixed. UrineCheck test(s) is/are read-to-use and disposable. No equipment is required for use. Only fresh and uncentrifuged urine samples without preservatives are to be used.

UrineCheck provides tests for Creatinine (C), Nitrite (N), pH (P), Specific Gravity (G), Glutaraldehyde (U), Bleach (B), and Pyridinium Chlorochromate (P) in urine. Test results may be useful for assessing the integrity of the urine sample while running Drugs-of-Abuse & Alcohol testing, for example, whether the sample is possibly diluted with water or other liquids as indicated by the Creatinine and specific gravity tests. UrineCheck detects whether the sample contains commercially available adulterants including nitrate, Glutaraldehyde, and other oxidizing agents. UrineCheck can also assess whether the sample is possibly contaminated by acidic (vinegar) or basic (ammonia solution) adulterants as indicated by the pH test.

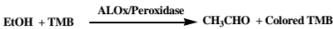
#### PRINCIPLE

##### Drugs of Abuse

Each component strip of the DOA/Alcohol Test Cup is based on the principle of specific immunochemical reaction between antibodies and antigen to analyse particular compounds in human urine specimens. The assay relies on the competition for binding antibody. When a drug is present in the urine specimen, it competes with drug conjugate for the limited amount of antibody-dye conjugate. When the amount of drug is equal or more than the cut-off, it will prevent the binding of drug conjugate to the antibody. Therefore, a positive urine specimen will not show a colored band on the test line zone, indicating a positive result, while the presence of a colored band indicates a negative result. A control line is present in the test window to work as procedural control. This colored band should always appear on the control line zone if the test device is stored in good condition and the test is performed appropriately.

#### Alcohol

Alcohol test is based on the high specificity of alcohol oxidase (ALOX) for ethyl alcohol in the presence of peroxidase and enzyme substrate such as tetramethylbenzidine (TMB) as shown in the following:



In general, all UrineCheck Tests are based on the chemical reactions of the indicator reagents on the pads with components in the urine sample affecting color changes. Results are obtained by comparing the color on each of the test pads with the corresponding pad on the color chart provided.

**Creatinine:** Testing for sample dilution. In this assay, Creatinine reacts with a Creatinine indicator in an alkaline condition to form a purplish-brown colour complex. The concentration of Creatinine is directly proportional to the color intensity of the test pad.

**Specific Gravity:** Testing for sample dilution. This test is based on the apparent pKa change of certain pretreated polyelectrolytes in relation to ionic concentration. In the presence of an indicator, the colours range from dark blue or blue-green in urine of low ionic concentration to green and yellow in urine of higher ionic concentration.

**pH:** Testing for the presence of acidic or alkaline adulterants. This test is based on the well-known double pH indicator method that gives distinguishable colors over wide pH range. The colors range from orange (low pH) to yellow and green to blue (high pH).

**Nitrite:** Testing for the presence of exogenous nitrite. Nitrite reacts with an aromatic amine to form a diazonium compound in an acid medium. The diazonium compound in turn couples with an indicator to produce a pink-red/purple colour.

**Oxidants:** Testing for presence of oxidizing reagents. In this reaction, a colour indicator reacts with oxidants such as hydrogen peroxide, ferricyanide, persulfate, or pyridinium chlorochromate to form a blue colour complex. Other colours may indicate the presence of other oxidants.

**Glutaraldehyde:** Testing for the presence of exogenous aldehyde. In this assay, the aldehyde group on the Glutaraldehyde reacts with an indicator to form a pink/purple colour complex.

**Bleach:** Testing for the presence of bleach in urine. In this test, the presence of bleach forms a blue-green, brown, or orange colour complex.

**Pyridinium Chlorochromate:** Testing for the presence of Pyridinium Chlorochromate in urine. In this test, the presence of chromate forms a blue-green colour complex.

#### MATERIALS PROVIDED

- Instructions for use**
- One Drugs of Matrix Key Cup, including Temperature Strip (with optional Alcohol and/or Adulteration Test)**

#### Drugs Of Abuse

The amount of each coated antigen and/or antibody on the strip is less than 1.0 mg for antigen conjugate and is less than 1.0 mg for antibody.

Test zone: contains antigen conjugates

Control zone: contains antibody

Conjugate pad: contains antibody.

#### Temperature Strip

Use the temperature Validator to verify the freshly collected urine. A visible green indicator shows the temperature detected and indicates the specimen is in a normal temperature range. Conversely, if no green indicator appears within the temperature strip, the temperature is either lower or higher than the normal temperature range (90°F-100°F / 32°C -38°C).

#### Alcohol (optional)

Each Alcohol test contains these materials:

Tetramethylbenzidine (TMB)	0.12 mg
Alcohol oxidase (EC)	0.5 IU
Peroxidase(EC)	35 IU
Proteins	0.15mg

#### Adulteration Test (optional)

- Alcohol /Adulteration Test Colour Chart (When order Alcohol and/or Adulteration Tests)**

#### MATERIAL REQUIRED BUT NOT PROVIDED

**Timer or clock.**

#### STORAGE AND STABILITY

The Matrix Key Cup should be stored at 2 to 30°C and will be effective until the expiration date stated on the package. The product is humidity-sensitive and should be used immediately after being open. Any improperly sealed product should be discarded.

#### PRECAUTIONS

- For in vitro diagnostic and forensic use only.
- Do not use the product beyond the expiration date.
- Handle all specimens as potentially infectious.
- Humidity sensitive product. Do not open foil pouch until it is ready to be tested.
- Use a new urine specimen cup for each sample to avoid cross contamination.

#### SPECIMEN COLLECTION AND PREPARATION

Fresh urine does not require any special handling or pretreatment. Specimens should be collected in a clean, dry, plastic or glass container. If the assay is not performed immediately, urine specimen may be refrigerated at 2-8 °C or frozen for up to 7 days. Specimens should be brought to room temperature before testing. Urine specimens exhibiting a large amount of precipitate or turbidity should be centrifuged or allowed to settle before testing. Avoid contact with skin by wearing gloves and proper laboratory attire.

#### QUALITY CONTROL

Good Laboratory practice recommends the daily use of control materials to validate the reliability of device. Control materials should be assayed as clinical specimen and challenging to the assay cutoff concentration, e.g., 50% above and below cutoff concentration. If control values do not fall within establish range, assay results are invalid. Control materials which are not provided with this test kit are commercially available.

#### Drugs of Abuse

The Matrix Key Cup provides a built-in process control with a different antigen/antibody reaction at the control region (C). This control line should always appear regardless the presence of drug or metabolite. If the control line does not appear, the test device should be discarded and the obtained result is invalid. The presence of this control band in the control region serves as 1) verification that sufficient volume is added, 2) that proper flow is obtained.

#### Alcohol

Alcohol test may be qualitatively verified by using a test solution prepared by adding 0.75 ml of ethanol alcohol into 240 ml of distilled water or negative urine control.

#### UrineCheck: Adulteration Test(s)

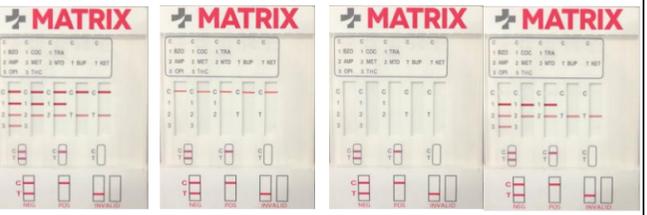
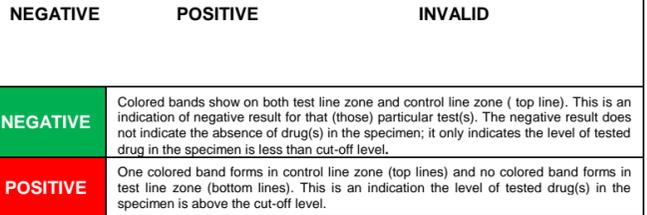
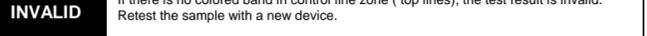
For best results, performance of UrineCheck test should be confirmed by testing known negative and positive specimens.

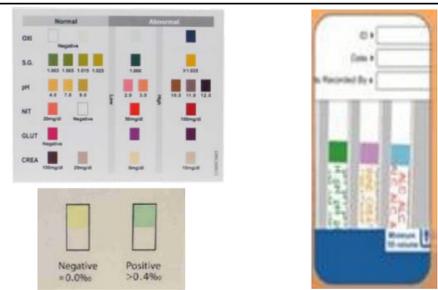
#### PROCEDUR

1
Bring tests, specimens, and/or controls to room temperature (60-86 F or 15-30 °C) before use.
2
Remove the Matrix Key Cup from sealed foil pouch.
3
Label the device with patient ID.

4	Put the key in the keyhole and Remove the lid.
5	Collect the sample and ensure that the sample is above the minimum fill line.
6	Close the cap,press firmly until you hear the click,place the Matrix Key Cup on a flat surface.
7	Use the temperature Validator to verify the freshly collected urine. Green indicator shows the temperature detected.
8	Read the results at 5 minutes
9	Remove the result window cover and read the results.

**Caution: Results after 10 minutes may not be accurate.**

INTERPRETATION OF RESULTS	
<b>DRUGS OF ABUSE</b>	
	
	
<b>NEGATIVE</b>	Colored bands show on both test line zone and control line zone ( top line). This is an indication of negative result for that (those) particular test(s). The negative result does not indicate the absence of drug(s) in the specimen; it only indicates the level of tested drug in the specimen is less than cut-off level.
<b>POSITIVE</b>	One colored band forms in control line zone (top lines) and no colored band forms in test line zone (bottom lines). This is an indication the level of tested drug(s) in the specimen is above the cut-off level.
<b>INVALID</b>	If there is no colored band in control line zone ( top lines), the test result is invalid. Retest the sample with a new device.

<b>ALCOHOL &amp; ADULTERATION</b>	
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**Note: A borderline(+/-) in test line zone should be considered negative result.**

#### LIMITATION OF PROCEDURE

The assay is designed for use with human urine only. A positive result with any of the tests indicates only the presence of a drug/metabolite and does not indicate or measure intoxication. There is a possibility that technical or procedural error as well other substances in certain foods and medicines may interfere with the test and cause false results. Please refer to the "SPECIFICITY" section for lists of substances that will produce either positive results, or that do not interfere with test performance. If a drug/metabolite is found present in the urine specimen, the assay does not indicate frequency of drug use or distinguish between drug of abuse and certain foods and medicines.

#### EXPECTED RESULTS

The Matrix Key Cup is a qualitative assay. It identifies the drug(s) in human urine at its cut-off concentration or higher. The concentration of the drug(s) cannot be determined by this assay. The test is intended to distinguish a negative result from presumptive positive result. All positive results must be confirmed using an alternate method, preferably GC/MS.

#### PERFORMANCE CHARACTERISTICS

##### A. Accuracy

The accuracy of the Matrix Key Cup was evaluated in each component strip and in comparison to GC/MS method at the following concentration: d-amphetamine 1000ng/ml (AMP), secobarbital 300 ng/m (BAR), oxazepam, 300 ng/ml (BZO), buprenorphine-3-β-d-glucuronide 10ng/ml (BUP), benzoylcegonine 300ng/ml (COC), EDDP 100ng/ml (EDDP), Ketamine 1000ng/ml (KET), methadone 300 ng/ml (MTD), MDMA 500ng/ml (MDMA), (+)methamphetamine 1000 ng/ml (MET), phencyclidine 300 ng/ml (PCP), morphine 300 ng/ml (OPI), morphine 2000 ng/ml (OPI II ), oxycodone 100ng/ml (OXY), nor-propoxyphene 300 ng/ml (PPX), 11-nor-Δ<sup>9</sup>-THC-9-COOH 50ng/ml (THC), Tramadol 200 ng/ml (TRA), Nortriptyline 1000 ng/ml (TCA),6-Acetylmorphine 10 ng/ml (6-MAM), Zolpidem Phenyl-4-carboxylic acid 50 ng/ml (ZOL), Lysergic acid diethylamide 20 ng/ml (LSD), 7-Aminoclonazepam 300 ng/ml (7-ACL), Pregabalin 500 ng/ml (PGB), Mescaline 300 ng/ml (MES), 3,4-Methylenedioxypropyvalerone 500 ng/ml (MDPV), Methcathinone 500 ng/ml (MCAT), Mephedrone 500 ng/ml (MEP), Gabapentin 2000 ng/ml (GAB), Carfentanil 500 ng/ml (CFYL), AB-PINACA 25 ng/ml (K2-AB),Caffeine 8000 ng/ml (CAF) Ethyl Glucuronide 500/1000 ng/m(ETG), JHW-018 and JWH-073 50 ng/ml(K2) Cotinine 200ng/ml(COT), Fentanyl 10 ng/ml(FYL) and Methaqualone 300 ng/ml(MQL). The results of each component strip are listed below:

1. **Amphetamine** The accuracy of the amphetamine test was evaluated in comparison to GC/MS method and commercial kits at a cut-off of 1000 ng/ml. Three hundred and forty five (345) urine specimens which composed of one hundred thirty three (133) d-amphetamine positive samples and two hundred twelve (212) negative samples were evaluated in this study. The results are summarised and presented below: Positive % agreement:98.5, Negative % agreement: 100

2. **Barbiturate** The accuracy of the barbiturate test was evaluated in comparison to GC/MS method and commercial kits at a cut-off of 300 ng/ml of secobarbital. One hundred and thirteen (113) urine specimens which composed of sixty four (64) barbiturate positive samples and forty nine (49) negative samples were evaluated in this study. The results are summarised below: Positive % agreement: 100, Negative % agreement: 100.

3. **Benzodiazepine** The accuracy of the benzodiazepine test was evaluated in comparison to GC/MS method and commercial kits at a cut-off of 300 ng/ml of oxazepam. Three hundred and forty four (344) urine specimens which composed of one hundred and eleven (111) benzodiazepine positive samples and two hundred and thirty three (233) negative samples were evaluated in this study. The results are summarised below: Positive % agreement: 98, Negative % agreement: 100

4. **Buprenorphine** The accuracy of the buprenorphine test was evaluated in comparison to GC/MS at a cut-off of 10 ng/ml of buprenorphine-3-β-d-glucuronide. One hundred and one (101) urine specimens which composed of forty nine (49) buprenorphine-3-β-d-glucuronide positive samples and fifty two (52) negative samples were evaluated in this study. The results are summarised below: Positive % agreement: 96, Negative % agreement: 100.

5. **Cocaine** The accuracy of the cocaine test was evaluated in comparison to GC/MS method and commercial kits at a cut-off of 300 ng/ml of benzoylcegonine. Three hundred and forty four (344) urine specimens which composed of one hundred and twenty one (121) benzoylcegonine positive samples and two hundred and twenty three (223) negative samples were evaluated in this study. The results are summarised below: Positive % agreement: 99, Negative % agreement: 99

6. **EDDP** The accuracy of the methadone metabolite (EDDP) test was evaluated in comparison to GC/MS method at a cut-off of 100 ng/mL EDDP. Ninety (99) specimens which composed of forty four (44) positive samples and forty five (45) negative samples were evaluated in this study. The results are summarized as below: Positive % agreement: 98, Negative % agreement:100

7. **Ketamine** The accuracy of the ketamine test was evaluated in comparison to GC/MS method and commercial kits at a cut-off of 1000 ng/ml of ketamine. Three hundred and forty four (344) urine specimens which composed of one hundred and twenty seven (127) ketamine positive samples and two hundred and seventeen (217) negative samples were evaluated in this study. The results are summarised below: Positive % agreement: 99, Negative % agreement: 100

8. **MDMA** The accuracy of the MDMA test was evaluated in comparison to GC/MS at a cut-off of 500 ng/ml of (+)methylenedioxyamphetamine. One hundred and eleven (111) urine specimens with GC/MS confirmed MDMA concentration were evaluated in this study. The results are summarised and presented below: Positive % agreement: 96, Negative % agreement: 95

9. **Methadone** The accuracy of the methadone test was evaluated in comparison to GC/MS method and commercial kits at a cut-off of 300 ng/ml of methadone. Three hundred and forty four (344) urine specimens which composed of one hundred and eighty seven (187) methadone positive samples and one hundred and fifty seven (157) negative samples were evaluated in this study. The results are summarised as below: Positive % agreement: 100, Negative % agreement: 100.

10. **Methamphetamine** The accuracy of the methamphetamine test was evaluated in comparison to GC/MS method and commercial kits at a cut-off of 1000 ng/ml of (+)methamphetamine. Three hundred and forty four (344) urine specimens which composed of one hundred and twenty eight (128) methamphetamine positive samples and two hundred and sixteen (216) negative samples were evaluated in this study. The results are summarized as below: Positive % agreement: 98, Negative % agreement: 100

11. **Opiate** The accuracy of the opiate test was evaluated in comparison to GC/MS method and commercial kits at a cut-off of 300 ng/ml of morphine. Three hundred and forty four (344) urine specimens which composed of one hundred and fifty nine (159) opiate positive samples and one hundred and eighty five (185) negative samples were evaluated in this study. The results are summarised as below: Positive % agreement:99, Negative % agreement: 99

12. **Opiate II** The accuracy of the opiate II test was evaluated in comparison to GC/MS method and commercial kits at a cut-off of 2000 ng/ml of morphine. One hundred and eight (108) urine specimens which composed of fifty three nine (53) opiate positive samples and fifty five (55) negative samples were evaluated in this study. The results are summarised as below: Positive % agreement: 94, Negative % agreement: 100.0.

13. **Oxycodone** The accuracy of the oxycodone test was evaluated in comparison to GC/MS method and commercial kits at a cut-off of 100

ng/ml of oxycodone. One hundred and forty four (140) urine specimens which composed of fifty eight (58) opiate positive samples and eighty two (82) negative samples were evaluated in this study. The results are summarized below: Positive % agreement: 100, Negative % agreement: 95

14. **Phencyclidine** The accuracy of the PCP test was evaluated in comparison to GC/MS method and commercial kits at a cut-off of 25 ng/ml of phencyclidine. Eighty (80) urine specimens which composed of thirty five (35) phencyclidine positive samples and forty five (45) negative samples were evaluated in this study. The results are summarised below: Positive % agreement: 98, Negative % agreement:95

15. **Propoxyphene** The accuracy of the propoxyphene test was evaluated in comparison to GC/MS method at a cut-off of 300 ng/ml of nor-propoxyphene. Ninety one (91) propoxyphene positive specimens with GC/MS confirmed nor-Propoxyphene concentration and forty (40) were evaluated in this study. The results are summarised below: Positive % agreement: 100, Negative % agreement:100

16. **THC** The accuracy of the THC test was evaluated in comparison to GC/MS method and commercial kits at a cut-off of 50 ng/ml of 11-nor-Δ<sup>9</sup>-THC-9-COOH. Three hundred and forty four (344) urine specimens which composed of seventy eight (78) THC positive samples and two hundred and sixty six (266) negative samples were evaluated in this study. The results are summarised below: Positive % agreement: 100, Negative % agreement: 99

17. **Tramadol** The accuracy of the tramadol test was evaluated in comparison to GC/MS at a cut-off of 200 ng/ml of tramadol. Eighty one (81) urine specimens with GC/MS confirmed tramadol concentration were evaluated in this study. The results are summarised and presented below: Positive % agreement: 95, Negative % agreement: 98

18. **TCA** The accuracy of the TCA test was evaluated in comparison to GC/MS at a cut-off of 1000 ng/ml of Nortriptyline. One hundred (100) urine specimens with GC/MS confirmed Nortriptyline concentration were evaluated in this study. The results are summarised and presented below: Positive % agreement: 98, Negative % agreement: 95

19. **6-MAM** The accuracy of the 6-MAM test was evaluated in comparison to GC/MS at a cut-off of 10 ng/ml of 6-Acetylmorphine. One hundred and twenty one (121) urine specimens with GC/MS confirmed 6-Acetylmorphine concentration were evaluated in this study. The results are summarised and presented below: Positive % agreement: 97, Negative % agreement: 100

20. **ZOL** The accuracy of the ZOL test was evaluated in comparison to GC/MS at a cut-off of 50 ng/ml of Zolpidem Phenyl-4-carboxylic acid. Ninety six (96) urine specimens with GC/MS confirmed Zolpidem Phenyl-4-carboxylic acid concentration were evaluated in this study. The results are summarised and presented below: Positive % agreement: 98, Negative % agreement: 99

21. **LSD** The accuracy of the LSD test was evaluated in comparison to GC/MS at a cut-off of 20 ng/ml of Lysergic acid diethylamide. Ninety five (95) urine specimens with GC/MS confirmed Lysergic acid diethylamide concentration were evaluated in this study. The results are summarised and presented below: Positive % agreement: 96, Negative % agreement: 98

22. **7-ACL** The accuracy of the 7-ACL test was evaluated in comparison to GC/MS at a cut-off of 300 ng/ml of 7-Aminoclonazepam. One hundred (100) urine specimens with GC/MS confirmed 7-Aminoclonazepam concentration were evaluated in this study. The results are summarised and presented below: Positive % agreement: 99, Negative % agreement: 100

23. **PGB** The accuracy of the PGB test was evaluated in comparison to GC/MS at a cut-off of 500 ng/ml of Pregabalin. One hundred and thirty two (132) urine specimens with GC/MS confirmed Pregabalin concentration were evaluated in this study. The results are summarised and presented below: Positive % agreement: 96, Negative % agreement: 98

24. **MES** The accuracy of the MES test was evaluated in comparison to GC/MS at a cut-off of 300 ng/ml of Mescaline. One hundred and nine (109) urine specimens with GC/MS confirmed Mescaline concentration were evaluated in this study. The results are summarised and presented below: Positive % agreement: 98, Negative % agreement: 100

25. **MDPV** The accuracy of the MDPV test was evaluated in comparison to GC/MS at a cut-off of 500 ng/ml of 3,4-Methylenedioxypropyvalerone. One hundred and six (106) urine specimens with GC/MS confirmed 3,4-Methylenedioxypropyvalerone concentration were evaluated in this study. The results are summarised and presented below: Positive % agreement: 99, Negative % agreement: 100

26. **MCAT** The accuracy of the MCAT test was evaluated in comparison to GC/MS at a cut-off of 500 ng/ml of Methcathinone. Eighty eight (88) urine specimens with GC/MS confirmed Methcathinone concentration were evaluated in this study. The results are summarised and presented below: Positive % agreement: 100, Negative % agreement: 97

27. **MEP** The accuracy of the MEP test was evaluated in comparison to GC/MS at a cut-off of 500 ng/ml of Mephedrone. Two hundred and three (203) urine specimens with GC/MS confirmed Mephedrone concentration were evaluated in this study. The results are summarised and presented below: Positive % agreement: 97, Negative % agreement: 99

28. **GAB** The accuracy of the GAB test was evaluated in comparison to GC/MS at a cut-off of 2000 ng/ml of Gabapentin. One hundred and fifty nine (159) urine specimens with GC/MS confirmed Gabapentin concentration were evaluated in this study. The results are summarised and presented below: Positive % agreement: 97, Negative % agreement: 100

29. **CFYL** The accuracy of the CFYL test was evaluated in comparison to GC/MS at a cut-off of 500 ng/ml of Carfentanil. One hundred and seventy eight (178) urine specimens with GC/MS confirmed Carfentanil concentration were evaluated in this study. The results are summarised and presented below: Positive % agreement: 98, Negative % agreement: 100

30. **K2-AB** The accuracy of the K2-AB test was evaluated in comparison to GC/MS at a cut-off of 25 ng/ml of AB-PINACA. Two hundred and twenty five (225) urine specimens with GC/MS confirmed AB-PINACA concentration were evaluated in this study. The results are summarised and presented below: Positive % agreement: 99, Negative % agreement: 98

31. **CAF** The accuracy of the CAF test was evaluated in comparison to GC/MS at a cut-off of 8000 ng/ml of Caffeine. One hundred and ninety four (194) urine specimens with GC/MS confirmed Caffeine concentration were evaluated in this study. The results are summarised and presented below: Positive % agreement: 95, Negative % agreement: 100

32. **ETG** The accuracy of the ETG test was evaluated in comparison to GC/MS at a cut-off of 500/1000 ng/ml of Ethyl-β-D-glucuronide. One hundred and eighty (180) urine specimens with GC/MS confirmed Ethyl-β-D-glucuronide concentration were evaluated in this study. The results are summarised and presented below: ETG500 Positive % agreement: 97, Negative % agreement: 100 ETG1000 Positive % agreement: 97, Negative % agreement: 100

33. **K2** The accuracy of the K2 test was evaluated in comparison to GC/MS at a cut-off of 50 ng/ml of JWH-018-5 pentanoic. One hundred and fifty-five (155) urine specimens with GC/MS confirmed JWH-018-5 pentanoic concentration were evaluated in this study. The results are summarised and presented below: Positive % agreement: 98, Negative % agreement: 98

34. **COT** The accuracy of the COT test was evaluated in comparison to GC/MS at a cut-off of 200 ng/ml of (-)-Cotinine. One hundred and sixty (160) urine specimens with GC/MS confirmed (-)-Cotinine concentration were evaluated in this study. The results are summarised and presented below: Positive % agreement: 99, Negative % agreement: 100

35. **FYL** The accuracy of the FYL test was evaluated in comparison to GC/MS at a cut-off of 200 ng/ml of Fentanyl. One hundred and seventy-five (175) urine specimens with GC/MS confirmed Fentanyl concentration were evaluated in this study. The results are summarised and presented below: Positive % agreement: 99, Negative % agreement: 100

36. **MQL** The accuracy of the MQL test was evaluated in comparison to GC/MS at a cut-off of 300 ng/ml of Methaqualone. Two hundred and five (205) urine specimens with GC/MS confirmed Methaqualone concentration were evaluated in this study. The results are summarised and presented below: Positive % agreement: 100, Negative % agreement: 98

**B. Sensitivity**

The cut-off concentrations (sensitivity level) of the Matrix Key Cup are determined to be: AMP 1000 ng/ml, BAR, 300 ng/ml, BZO 300 ng/ml, BUP 10 ng/ml, COC 300 ng/ml, EDDP 100 ng/ml, KET 1000 ng/ml, MTD 300 ng/ml, MET 1000 ng/ml, MDMA 500 ng/ml, OPI 300 ng/ml, OPI II 2000 ng/ml, OXY 100 ng/ml, PCP 25 ng/ml, PPX 300 ng/ml, THC 50 ng/ml, 200ng/ml of TRA, TCA 1000 ng/ml, 6-MAM 10 ng/ml, ZOL 50 ng/ml, LSD 20 ng/ml, 7-ACL 300 ng/ml, PGB 500 ng/ml, MES 300 ng/ml, MDPV 500 ng/ml, MCAT 500 ng/ml, MEP 500 ng/ml, GAB 2000 ng/ml, CFYL 500 ng/ml, K2-AB 25 ng/ml and CAF 8000 ng/ml. ETG 500/1000 ng/ml, K2 50 ng/ml, COT 200 ng/ml, FYL 10 ng/ml and MQL 300 ng/ml.

**C. Precision**

The precision of the Matrix Key Cup was determined by conducting the test with spiked controls and interpreting the results by three individuals to verify the random error of visual interpretation. The results of 40 samples each of 50% above and 50% below cut-off specimens are 100% agreed by three observers. The test results were found to have no significant differences between these three observers.

**D. Specificity**

The specificity for the Matrix Key Cup was tested by adding various drugs, drug metabolites, and other compounds that are likely to be present in urine. All compounds were prepared in drug-free normal human urine.

**1. Interference testing**

The performance of the Matrix Key Cup at cut-off level is not affected when pH and Specific Gravity ranges of urine specimen are at 4.5 to 9.0 and 1.005 to 1.035.

The following substances were tested and confirmed did not interfere with the Matrix Key Cup at the concentrations listed below.

Glucose	2000 mg/dl
Human albumin	2000 mg/dl
Human hemoglobin	10 mg/dl
Urea	4000 mg/dl
Uric acid	10 mg/dl

**2. Specificity**

The following table lists compounds that are detected by the Matrix Key Cup which produced positive results when tested at levels equal or greater than the concentrations listed below.

Tests	Compounds	Cut-off (ng/ml)
Amphetamine	D-Amphetamine	1,000
	l-Amphetamine	>100,000
	d-methamphetamine	>100,000
	l-methamphetamine	>100,000
	3,4-Methylenedioxyamphetamine	1,250
	3,4-Methylenedioxy-methamphetamine	>100,000
	3,4-Methylenedioxyethylamphetamine	>100,000
	Paramethoxyamphetamine	625
	Phentermine	1250
	Tyramine	>100,000
	Barbiturate	Secobarbital
Allobarbitol		1250
Alphenal		625
Amobarbital		625
Aprobarbital		188
Butabarbital		94
Butalbital		2500
Butethal		200
Cyclopentobarbital		400
Pentobarbital		1,000
Phenobarbital		300
Buprenorphine	Buprenorphine	5
	Buprenorphine-3-β-D-Glucuronide	5
	Norbuprenorphine	25
	Norbuprenorphine-3-β-D-Glucuronide	50
Benzodiazepines	Oxazepam	300
	Alprazolam	125
	Bromazepam	625
	Chlordiazepoxide	2500
	Clobazam	63
	Clonazepam	2500
	Clorazepate	3330
	Desalkylurazepam	250
	Diazepam	250
	Estazolam	5000
	Fentanyl	>100,000
	Flunitrazepam	375
	Flurazepam	>100,000
	Lorazepam	1250
	Lormetazepam	1250
	Medazepam	>100,000
	Midazolam	>100,000
	Nitrazepam	25000
	Norchlordiazepoxide	250
	Nordiazepam	500
Prazepam	>100,000	
Temazepam	63	
Triazolam	5000	
Cocaine	Benzoyllecgonine	300
	Cocaine	1,000
	Ecgonine	100,000
	Ecgonine Methyl Ester	>100,000
EDDP	EDDP	100

Ketamine	Meperidine	>100,000	
	Methadone	>100,000	
	Norfentanyl	>100,000	
	Phencyclidine	>100,000	
	Promazine	50000	
	Promethazine	25000	
	Prothipendyl	50,000	
	Prozine	12500	
	Ketamine	1,000	
	Norketamine	1,000	
MDMA	Dextromethorphan	500	
	3,4-Methylenedioxy-methamphetamine	500	
	d-Amphetamine	>100,000	
	l-Amphetamine	>100,000	
	d-methamphetamine	>100,000	
	l-methamphetamine	>100,000	
	3,4-Methylenedioxyamphetamine	2,500	
	3,4-Methylenedioxyethylamphetamine	156	
	Paramethoxyamphetamine	50,000	
	Paramethoxymethamphetamine	>100,000	
Methamphetamine	d-Methamphetamine	1,000	
	Chloroquine	25,000	
	Fenfluramine	12,500	
	l-Methamphetamine	1,000	
	Mephentermine hemisulfate salt	31250	
	3,4-Methylenedioxyethylamphetamine	50000	
	3,4-Methylenedioxy-methamphetamine	313	
	Paramethoxymethamphetamine	625	
	(-)-Ephedrine	4000	
	Methadone	300	
Methadone	(-)-alpha-methadol	2,000	
	Opiate	Morphine	300
		Acetylcodeine	150
		Buprenorphine	>10000
		Codeine	250
		Diacetyl Morphin	250
		Dihydrocodeine	586
		Ethylmorphine	200
		Hydrocodone	12500
		Hydromorphone	12500
6-Monoacetylmorphine		250	
Opiate II	Morphine-3-glucuronid	2500	
	Nalorphine	25000	
	Thebaine	25000	
	Morphine	1000	
	Acetylcodeine	1000	
	Buprenorphine	>10000	
	Codeine	1000	
	Diacetylmorphine (Heroin)	3000	
	Dihydrocodeine	1000	
	Ethylmorphine	200	
OXY100	Hydromorphone	25000	
	Hydrocodone	50000	
	Merperidine	>100,000	
	6-Monoacetylmorphine (6-MAM)	3000	
	Morphine-3-β-d-glucuronide	10000	
	Nalorphine Hydrochloride	>100,000	
	Oxycodone	>100,000	
	Oxymorphone	>100,000	
	Rifampicine	>100,000	
	Thebaine	50000	
PCP	Oxycodone	100	
	Hydrocodone	6250	
	Hydromorphone	50000	
	Naloxone	50000	
	Oxymorphone	250	
	Phencyclidine	25	
	Hydrocodone	>100,000	
	Hydromorphone	>100,000	
	4-hydroxyphencyclidine	75	
	D-Propoxyphene	300	
Propoxyphene	D-Norpropoxyphene	5000	
	Nortriptyline HCl	1000	
	Amitriptyline	150	
	Clomipramine	>100000	
TCA	Cyclobenzaprine	12500	

Desipramine	Desipramine	188	
	Doxepin	2000	
	Imipramine	2500	
	Maprotiline	750	
	Nortriptyline	3125	
	Nordoxepin	500	
	Opipramol	1563	
	Promazine	1000	
	Promethazine	6250	
	Prothipendyl	25000	
THC	Protryptiline	6250	
	Prozine	1250	
	Trimipramine	>100,000	
	11-nor-Δ9-THC-9-COOH	25	
	11-nor-Δ8-THC-9-COOH	15	
	Δ 8-Tetrahydrocannabinol	7500	
	Δ 9-Tetrahydrocannabinol	7500	
	Cannabinol	10000	
	Cis-Tramadol	200	
	Tramadol	N-Desmethyl-cis tramadol	500
O-Desmethyl-cis tramadol		20,000	
Netrexone		10,000	
Tetrahydrozoline		10,000	
Dihydrocodeine		50,000	
6-Monoacetylmorphine		10	
Acetylcodeine		>10,000	
Buprenorphine		>10,000	
Codeine		>10,000	
Diacetylmorphine		1000	
6-MAM	Dihydrocodeine	>10,000	
	Ethylmorphine	>10,000	
	Hydrocodone	>10,000	
	Hydromorphone	5000	
	Morphine	10000	
	Morphine-3-glucuronide	>10,000	
	Nalorphine	5000	
	Thebaine	>20,000	
	Zolpidem Phenyl-4-carboxylic	50	
	Zolpidem	>10,000	
ZOL	Lysergic acid diethylamide	20	
	7-amine-clonazepam	300	
	Oxazepam	>10,000	
	Alprazolam	>10,000	
	Bromazepam	>10,000	
	Chlordiazepoxide	>10,000	
	Clobazam	>10,000	
	Clonazepam	10,000	
	Clorazepate dipotassium	>10,000	
	Desalkylflurazepam	>10,000	
LSD	Diazepam	>10,000	
	Estazolam	>10,000	
	Flunitrazepam	>50,000	
	(±) Lorazepam	10,000	
	Midazolam	>100,000	
	Nitrazepam	>10,000	
	Norchlordiazepoxide	>100,000	
	Nordiazepam	>100,000	
	Temazepam	>10,000	
	PGB	Pregabalin	500
MES	Mescaline	300	
MDPV	MDPV	500	
MCAT	Methcathinone	500	
	4-MMC (Mephedrone)	520	
	3-MMC (3-methylmethcathinone)	500	
	4-MEC (4-methylethcathinone)	550	
	Cathinone	>100,000	
	MDPV	>10,000	
	MEP	Mephedrone	500
	GAB	Methcathinone	500
		Gabapentin	2000
		Pregabalin	>100000
CFYL	CarFentanyl	500	
	Fentanyl	100	
K2-AB	AB- PINACA	25	
	AB-Fubinaca	40	
	UR-144 5-Pentanoic acid metabolite	5,000	

CAF	UR-144	>10,000
	AKB48	>10,000
	Caffeine	8,000
ETG	Theophylline	100,000
	Ethyl Glucuronide	500
	Ethanol	>100,000
	D-Glucuronic Acid	>100,000
ETG II*	Morphine-3-b-D-glucuronide	>100,000
	Ethyl Glucuronide	1000
FYL	Fentanyl and Fentanyl metabolites	10
	Fentanyl	100
	Norfentanyl	>10,000
COT	(-)-Cotinine	200
	(-)-Nicotine	6250
MQL	Methaqualone	300
	Amitriptyline	50,000
	Carbamazepine	20,000
	Nortriptyline	50,000
	Phenytoloin	40,000
	Theophylline	40,000

The following compounds show no cross-reactivity at concentrations up to 100 ug/mL unless specified in the table above.

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