

# Institute of Forensic Medicine

## Chair of Forensic Medicine

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### Research Focus

- Development and validation of PCR-multiplex systems for forensic DNA analysis
- Comparison of laser and mercury-arc lamp for the detection of body fluids on different substrates
- Highly sensitive simultaneous detection of psychoactive drugs and their metabolites using UPLC/MS-MS

### Structure of the Department

The Institute of Forensic Medicine with its divisions forensic medicine, forensic genetics, and forensic toxicology belongs to the clinical theoretical institutes of the FAU. Beside responsibilities in the field of research and education, official expertises are made for other medical facilities and by order of justice, for prosecution, and police authorities in the North Bavarian region. Moreover - even though less frequently - services are offered to private persons, lawyers, probation officers, and insurance companies. Predominantly, expertises are related to forensic investigations on injury patterns including crime reconstruction in the case of domestic violence, child abuse, and criminal assault. In the case of deceased, the expertises include statements on the cause of death as well as on specific questions (accident? suicide? homicide?). Genetic analyses are carried out for clarification of personal identity, for the individual assignment of biological specimen, and in paternity cases. Toxicological analyses are done to ascertain poisoning and to evaluate personal capacities at a definite time (fitness to drive? criminal responsibility?). The determination of the alcohol concentration is performed in body fluids of dead and living persons. Many findings are used in diagnostic procedures and for the con-

trol of therapies applied by different hospitals as well as medical practices.

### Research

#### Development and validation of PCR-multiplex systems for forensic DNA analysis

Project manager: PD Dr. T. Lederer  
Since the beginning of the development of molecular methods for forensic stain analysis and paternity testing in 1985, in particular the PCR (polymerase chain reaction)-based typing of STR (short tandem repeat)-polymorphisms has been spread around the world. Not only due to a large number of successful investigations which can be put down to the establishment of national and international databases, DNA analysis can be regarded as an indispensable tool in forensic casework analysis. In 1998, the Federal Criminal Police Office of Germany (BKA) established a central genetic database of offenders and suspects to facilitate comparisons with biological samples of future criminal offenses.

In our recent work, a variety of PCR-multiplex systems was established which allows the simultaneous amplification of up to twelve autosomal STR markers. It could be shown that all multiplexes are robust and reliable typing tools for a diversity of forensic specimen and are well suited in the case of paternity testing.

It has already been mentioned that national and international databases for genetic profiles and a cross-national usage of these data are an important tool of investigations by the police. An European-wide standardization and extension of the respective databases as well as the establishment of new typing systems is in the focus of current discussions and developments. Therefore, within our work, the existing multiplex systems were expanded by five more STR-loci ("European recommended loci"). Furthermore, population data of the new markers have been surveyed.

Beside autosomal polymorphisms, gonosomal localized systems play an upcoming role in the forensic diagnostics. In particular, y-chromosomal DYS-systems have to be mentioned in this context. These systems are well qualified for stain and paternity testing. However, the basis of a further distribution of these systems will be the establishment of worldwide databases containing haplotype frequencies and the development of PCR-multiplex systems. Because of that reason, different analysis-systems for these markers were established.

#### Comparison of laser and mercury-arc lamp for the detection of body fluids on different substrates

Project manager: Prof. Dr. S. Seidl

The performance of two detection techniques for body fluids, the Spectra-Physics Reveal portable forensic laser system and the mercury-arc lamp Lumatec Superlite 400, was evaluated with various biological stains on different substrates. Serial dilutions of neat, 1/10, 1/100 and 1/1,000 using fluid semen, saliva, urine, and blood were applied on glazed tiles, glass, PVC, wood, metal, stone, formica, carpet, and cotton. Apart from the fact that blood traces were not detectable with the laser, both light sources showed comparable results regarding their detection capability. Clear advantages of the Lumatec Superlite 400, however, are its lower size, weight, and purchase costs as well as the possibility to operate this light source by battery.

#### Highly sensitive simultaneous detection of psychoactive drugs and their metabolites using UPLC/MS-MS

Project manager: Dr. K. Müller

The availability of the coupling of liquid chromatography with mass spectroscopy enables more and more the finding and quantification of uncommon analytes and the parallel detection of a parent compound with phase-I- and phase-II-metabolites. Such results allow increasingly better estimation about acute influence, time, and frequency of consumption and if applicable to individual variants in genetic polymorphisms of the metabolic enzymes.

Especially the analysis of samples of elder people or the suspicion of the administration of a rape drug should lead to the possible detection of a singular exposition. Target compounds are not the classical illicit drugs, but the active agents of pharmaceutical products. Matrix could be especially blood, urine, and hair.

The purchase of an UPLC/MS-MS instrument offers the possibility of an extremely sensitive and specific analysis of a great number of compounds in different biological matrices. Up to now, we established sample preparation procedures and detection routines for 48 psychotropics and their active metabolites (i.e. sedatives, antidepressants, narcotics, antipsychotics). Predominantly these procedures have already passed an external audit. Furthermore, the simultaneous detection of opiates and their glucuronides and the quantification of ethylglucuronide as a specific metabolite of ethanol were validated.

## Teaching

The Institute of Forensic Medicine performs the education given by the Statutes of the Medical Act (ÄAppO) for students residing in the clinical part of the study course human medicine. This includes lectures, seminars, and specific activities. In addition, courses are held for students of the faculty of justice and the faculty of natural sciences as well as for medical students from the University of Regensburg. Although research associations with other facilities of the university do not exist in the classical sense due to the specific character of the subject "forensic medicine", many smaller cooperations with clinical and theoretical disciplines are maintained. Furthermore students are welcome during the whole year to sit in on autopsies, court trials, and practical courses in the field of forensic analytic.

## Selected Publications

Grobosch T, Schwarze B, Stoecklein D, Binscheck T (2012) Fatal poisoning with *Taxus baccata*: quantification of paclitaxel (taxol A), 10-deacetyltaxol, baccatin III, 10-deacetylbaccatin III, cephalomannine (taxol B), and 3,5-dimethoxyphenol in body fluids by liquid chromatography-tandem mass spectrometry. *J Anal Toxicol*, 36: 36-43

Schietke RE, Hackenbeck T, Tran M, Günther R, Klanke B, Warnecke CL, Knaup KX, Shukla D, Rosenberger C, Koesters R, Bachmann S, Betz P, Schley G, Schödel J, Willam C, Winkler T, Amann K, Eckardt KU, Maxwell P, Wiesener MS (2012) Renal Tubular HIF-2 $\alpha$  Expression Requires VHL Inactivation and Causes Fibrosis and Cysts. *PLoS ONE*, 7: e31034

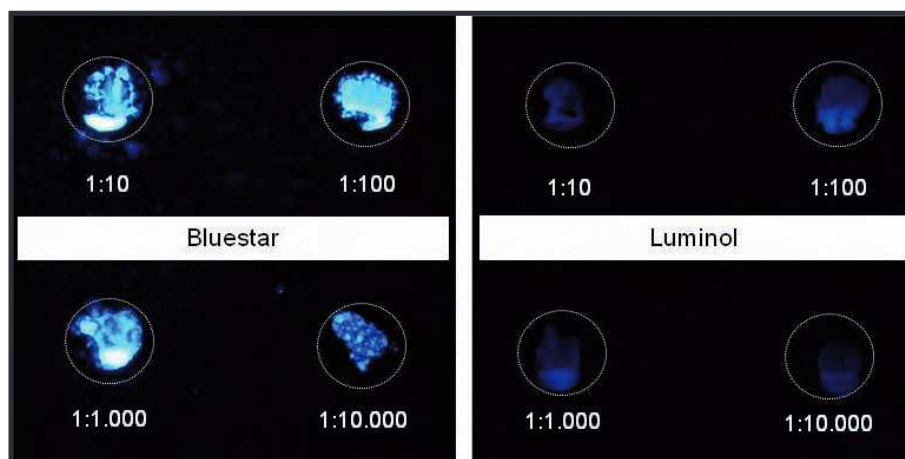
Wiest I, Alexiou C, Kuhn C, Schulze S, Kunze S, Mayr D, Betz P, Jeschke U, Dian D (2012) Expression of different carbohydrate tumour markers and galectins 1 and 3 in normal squamous and malignant epithelia of the upper aerodigestive tract. *Anticancer Res*, 32: 2023-9

Grobosch T, Schwarze B, Felgenhauer N, Riesselmann B, Roscher S, Binscheck T (2013) Eight cases of fatal and non-fatal poisoning with *Taxus baccata*. *Forensic Sci Int*, 227: 118-26

## Research Equipment

Applied Biosystems, DNA-Sequenzier

Waters, UPLC/MS-MS



Luminescence signals of different blood-dilutions on carpet using the reagents "Bluestar" (left) and "Luminol" (right)