Departments and Institutes
Ulm University Medicine is comprised of 10 preclinical institutes, 11 clinical-theoretical institutes, 34 medical institutes and departments and 3 co-opted institutes. Some of these have been combined to create Medical Centers. The institutes and departments are described on the following pages.
## Departments and Institutes

### Preclinical Institutes
- Institute of Anatomy and Cell Biology
- Institute of Molecular and Cellular Anatomy
- Institute of General Physiology
- Institute of Applied Physiology
- Division of Neurophysiology
- Institute of Physiological Chemistry
- Institute of Biochemistry and Molecular Biology
- Institute of General Medicine
- Institute of the History, Philosophy and Ethics of Medicine
- Institute of Epidemiology and Medical Biometry

### Clinical-theoretical Institutes
- Institute of Forensic Medicine
- Institute of Pathology
- Institute of Virology
- Institute of Molecular Virology
- Institute of Immunology
- Institute of Medical Microbiology and Hospital Hygiene
- Institute of Human Genetics
- Institute of Pharmacology and Toxicology
- Institute of Naturopathic Medicine and Clinical Pharmacology
- Institute of Experimental Cancer Research
- Institute of Research in Rehabilitation Medicine at Ulm University

### Medical Departments and Institutes

#### Center for Internal Medicine
- Department of Internal Medicine I
- Department of Internal Medicine II
- Department of Internal Medicine III
- Institute of Transfusion Medicine
- Division of Gene Therapy

#### Center for Surgery
- Department of General and Visceral Surgery
- Department of Orthopedic Trauma, Hand, Plastic and Reconstruction Surgery

#### Hospitals

#### Center for Dentistry
- Department of Conservative Dentistry and Periodontology
- Department of Prosthetic Dentistry
- Department of Oral and Maxillofacial Surgery
- Department of Dentofacial Orthopedics and Orthodontics

#### Co-opted Institutes
- Institute of Laser Technology in Medicine and Metrology (ILM)
- Institute of Psychology and Education
- Institute of Molecular Medicine, Stem Cells and Aging
The Institute of Anatomy and Cell Biology is concerned with research in the area of molecular neuroscience and teaches human anatomy to students studying molecular medicine, medicine and dentistry. The *prosektur* is also part of the institute. It has in all about 30 employees among whom are two professors (Prof. Tobias M. Böckers and Prof. Nikola Golenhofen), postdocs, PhD students and several medical students.

Our research topics concentrate on synaptic contacts within the central nervous system. Glutamatergic synapses in the central nervous system are specific cellular junctions that are characterized by synaptic vesicles attached to the active zone of the presynapse and an electron-dense web underneath the postsynaptic membrane known as the postsynaptic density (PSD). The pre- and postsynaptic membranes are interconnected by synaptic cell adhesion proteins (i.e. neurexin-neuroligin, cadherins) that are analyzed in the lab. PSDs are composed of a dense network of several hundred different proteins that creates a macromolecular complex serving a wide range of different functions. Prominent PSD proteins, such as members of the MaGuk or ProSAP/Shank family, build up a dense scaffold that creates an interface between clustered membrane-bound receptors, cell adhesion molecules and the actin-based cytoskeleton. The synaptic rearrangement (structural

Hippocampal neuron in culture immunostained for a dendritic marker (red) and a synaptic molecule (Abi-1) in green.
plasticity) is a rapid process and is believed to underlie learning and memory formation. The characterization of synapse/PSD proteins is especially important in light of recent data that suggest that several mental disorders have their molecular defect at the synapse/PSD level. The generation of induced pluripotent cells (iPS cells) from patients that can be differentiated into neurons of different kinds will help in understanding the pathophysiology of neuropsychiatric disorders.

The research group of Prof. Golenhofen investigates the role of several cell adhesion molecules within synaptic contact zones during development and plastic changes. Moreover, the group elucidates the physiological function of heat shock proteins in neurons, with respect to degeneration and regeneration, as well as in different neurological disease models.

Selected Publications:


• Schmeisser MJ and Boeckers TM Shank2 and ProSAP1/Shank2 Mouse Models of Autism. Autism Volume 2, 4; 1000006 (2013).
Cross section through the adult mouse hippocampus. Expression of the transcription factors Bcl11a/CTIP1 (red) and Bcl11b/CTIP2 (green) is visualized by employing specific antibodies against these proteins.

Institute of Molecular and Cellular Anatomy
Head of Institute: Prof. Dr. Stefan Britsch
Keywords: transcription factors | hippocampus | spinal cord | microRNA | spines | dendrites

Research Group: Transcriptional Control of Neural Development
Head: Prof. Dr. Stefan Britsch

The ability of the mature nervous system to integrate, compute and distribute information is based on developmental processes that create diversity, connectivity and the spatial organization of neurons. We are interested in the identification and functional characterization of transcriptional networks regulating these processes. Recent work from our group demonstrated that the zinc finger transcription factors Bcl11a/CTIP1 and Bcl11b/CTIP2 are critical regulators of neural development.

Hippocampal Neurogenesis

The development of the hippocampus, a major brain structure involved in learning and memory, starts early in embryogenesis and continues postnatally. The dentate gyrus, the primary gateway for input information into the hippocampus, is one of only two brain regions with continuous neurogenesis in adult mammals. We found that Bcl11b, as expressed in postmitotic cells, is required for postnatal development as well as adult neurogenesis of the dentate gyrus. Our data reveal phase-specific functions of Bcl11b demonstrated by feedback control of the progenitor cell compartment as well as a cell-autonomous arrest of neuronal differentiation leading to impaired learning and memory behavior. Further studies will focus on elucidating the mechanism of Bcl11b regulation of neurogenesis and its role in neurodegenerative diseases as well as in the aging process.
Dorsal Spinal Cord Development

Dorsal spinal cord neurons receive and integrate somatosensory information provided by neurons located in dorsal root ganglia. We uncovered that Bcl11a is essential for development of the dorsal spinal cord. Conditional ablation of the Bcl11a gene in mice revealed that dorsal spinal neurons require Bcl11a for terminal differentiation and morphogenesis. Moreover, a subset of cutaneous sensory afferents depends on Bcl11a in postsynaptic spinal target neurons to be able to grow into the dorsal horn and to form neuron circuits. Using transcriptome analysis and ChIP-on-embryos we identified the secreted frizzled-related protein-3 (sFRP3, Frzb) as a direct transcriptional target of Bcl11a in spinal neurons. Phenotypes of both, Bcl11a and Frzb deficient dorsal spinal cords, overlap demonstrating Frzb to be a functional downstream component of Bcl11a-dependent regulatory pathways in spinal neurons.

Research Group: Molecular Mechanisms of Neuronal Connectivity

Head: Prof. Dr. Stefan Schumacher

MicroRNAs are small noncoding RNAs which posttranslationally regulate gene expression. They are likely to have key roles in neuronal development and plasticity. We are interested in microRNA targets that contribute to the establishment of proper neuronal connectivity. Our focus is on the function of the small GTPase RhoG, the expression of which is regulated by the microRNA miR-124. This microRNA is specifically expressed in the nervous system. We found that miR-124-regulated RhoG inhibits axonal branching acting via an ELMO/Dock180/Rac1 signaling pathway. Additionally, RhoG was shown to reduce dendritic branching in a Cdc42-dependent manner. Thus, RhoG emerges as a cellular conductor of Rac1 and Cdc42 activity, in turn regulated by miR-124 to control axonal and dendritic branching.
The pulmonary alveolus is a unique structure that dwells in a delicate micro-environment between air and blood. With a diameter of about 200 mm, each alveolus contains a highly curved air-liquid interface, which has the tendency to collapse and makes the lung an intrinsically unstable organ. To prevent alveolar collapse, epithelial cells must secrete surfactant, a lipid-rich, lipoprotein-like substance, stored within so-called “lamellar bodies,” the storage vesicles of pulmonary epithelial type II pneumocytes. In addition, alveolar epithelial cells must continuously reabsorb electrolytes and water to keep the alveolus “dry.”

Aiming at an integrative approach using primary epithelial cell cultures on permeable and flexible membranes, the group investigates mechanisms of cellular mechanotransduction (stress – response coupling), Ca2+ signaling, electrolyte transport (Ussing chamber), fluid reabsorption (D2O dilution method) and surfactant transformation at the air-liquid interface (inverted interface).
Research Group: Molecular Mechanisms of Cellular Secretion

Head: Prof. Dr. Manfred Frick

Our lab is interested in the molecular mechanisms that regulate cellular secretion. Regulated secretion is a fundamental process in almost all types of eukaryotic cells. In particular, we study secretion of pulmonary surfactant. Pulmonary surfactant is secreted via exocytosis of lamellar bodies and constitutes an ideal model to study cellular secretion of large macromolecular complexes. We use high-resolution, live-cell imaging techniques to investigate molecular mechanisms that regulate individual stages of the exocytic secretion process – from initiation of membrane fusion to post-fusion vesicle compression. Overall, it is our aim to provide a mechanistic model of the sequential molecular interactions that are necessary for efficient secretion of macromolecular complexes.

In addition, we are interested in the role of purinergic signaling for maintaining alveolar homeostasis. Encouraged by a recent discovery that lamellar body exocytosis, surfactant secretion and fluid resorption in the alveolus are intimately linked via purinergic signaling we want to further elucidate the role of purinergic receptor activation for maintaining alveolar homeostasis under physiological and pathological conditions.

Selected Publications:

Research Group: Molecular Neurophysiology
Prof. Dr. Birgit Liss

Our research is focused on the dopamine midbrain system. This system is not only involved in motor control and neurodegenerative disorders, like Parkinson's disease (PD), but it is also crucial for emotional and cognitive brain functions and related disorders, like schizophrenia, drug addiction, or attention-deficit hyperactivity-disorder (ADHD). Our central aim is to define molecular mechanisms and signaling pathways that control cell-specific dopaminergic activity and selective pathophysiology of the dopamine midbrain system, in particular, in aging and PD. To address these issues, we analyze function and molecular biology of individual neurons at different ages from mouse-models, as well as from post mortem human brains. We do this by combining functional analysis (electrophysiology, calcium-imaging) with molecular techniques (UV-lasermicrodissection, quantitative RNA, DNA, and protein analysis) at the level of individual cells. We focus on ion-channels and receptors since their cell-specific activity directly defines individual neuronal activity patterns in health and disease. We aim to define new potential targets for the development of novel, more specific pharmacological therapeutic strategies for distinct diseases of the dopamine system.
Research Groups: Potassium Channels and Calcium Signaling
Prof. Dr. Stephan Grissmer & PD Dr. Werner Melzer

Our overall aim is to guide rational drug design to be specific for each ion channel type and for the therapy of related diseases.

We analyze properties, modifications and modulations of ion channels and receptors in the context of their roles in cellular function in health and diseases. We use molecular biological techniques in combination with electrophysiology to study structure function relationships of potassium channels with the goal of designing drugs for the modulation of ion channel function. We used different modifiers of potassium channels in combination with site-directed mutagenesis to identify the availability of the binding sites in different states of the channels. We also investigate mechanisms of excitation-contraction (EC) coupling in skeletal muscle. We focus on the release of calcium ions stored in the sarcoplasmic reticulum (SR) that initiates the motor activity of muscle. Changes in the EC coupling are observed in aging, in muscle fatigue and in certain diseases. Point mutations in the ryanodine receptor (RyR), the ion channel that releases calcium from the SR under the control of cell membrane voltage, can lead to malignant hyperthermia (MH) or central core disease (CCD). We are studying the functional alterations of EC coupling using single muscle fibers of mice expressing human RyR mutations.

Selected Publications:
Division of Neurophysiology

Head of Division: Prof. Dr. Dr.h.c. Frank Lehmann-Horn, Senior Research Professor for Neurosciences of the non-profit Hertie-Foundation

Keywords: Translational research on channelopathies | periodic paralyses | Duchenne muscular dystrophy | 23Na magnetic resonance imaging | Rare Disease Center

Our institute employs 14 members, of whom 50% are women. Native languages differ from German by 21%. Four PhD students and seven members contribute to the organization of the Zentrum Seltene Erkrankungen (ZSE) ("Center for Rare Diseases") in Ulm which opened in September 2011 and celebrated its first anniversary in June 2012 (Fig. 1).

Translational Research on Channelopathies

Through genetic linkage studies, candidate gene approach and exome sequencing, we identify genes for diseases in which we have detected altered channel function by electrophysiological methods. We clarify their pathogenesis on the molecular level by functional expression of the mutant channels using the patch clamp technique. Then we try to identify pharmaceutics on the market which counteract the mutation effects. Finally, we administer appropriate compounds to patients by off-label use.
Responses of WT and mutant R1242G channels to an electric ramp (1 min pre-depolarization to +30 mV followed by a ramp from +30 mV to -140 mV over 7 s). The red triangles represent the short circuit. Subtraction of linear passive current was done by holding potential at -90 mV. Data are shown as means ± SEM. Notable is the voltage across the membrane.

A scientific highlight was the first description of a genetic form of a compartment syndrome characterized by muscle swelling, electrically silent contractures and drop foot after moderate exercise. Sequencing of genes involved in the initiation of muscle contraction identified a missense mutation in the voltage-gated calcium channel, Cav1.1. The mutation is situated in the voltage sensor of the channel. One of the remarkable findings is a short circuit through this channel as a consequence of the mutation (Fan et al. 2013) (Fig.1).

An academic highlight was the Gaetano Conte Award for Basic Muscle Research given to PD Karin Jurkat-Rott in Athens in October 2013.

Several advocacy groups have listed our address as channelopathy experts. This motivated us to initiate the ZSE which we organize on behalf of the University Hospital Ulm.

Selected Publications:
• Fan C, Lehmann-Horn F, Weber MA, Bednarz M, Groome JR, Jonsson MKB, Jurkat-Rott K (2013): Transient compartment-like syndrome and normokalaemic periodic paralysis due to a Cav1.1 mutation. Brain, 136: 3775-3786. This publication was selected as paper of the month by the BMBF.
The Institute of Physiological Chemistry, located in the new life science building of the university, has about 40 members and most of these receive funding from third parties. The research groups of Prof. Wirth and Prof. Knöll study the role of different signaling pathways and transcription factors in development and disease, and both are involved in the teaching of students of medicine, dental medicine, molecular medicine, biochemistry and biology.

**Research Group: Signaling in Development and Disease**  
Head: Prof. Dr. Thomas Wirth

Investigation of the role of IKK/NF-κB signaling in inflammatory processes and the contribution of this pathway to disease development and progression represents a major research program. For these studies we have developed sophisticated genetic tools to allow the analysis of the role of this pathway in mouse models in a conditional way. This means that we can reversibly induce or block this pathway in a cell type/organ-specific manner. We were able to demonstrate that IKK/NF-κB signaling is a driver of inflammatory cardiomyopathy, a disease that is one of the most important causes for heart transplantation in young patients. Furthermore, excess IKK/NF-κB activity in pancreatic β-cells causes inflammatory diabetes mellitus whereas astroglial NF-κB-induction results in neuroinflammation that has variable consequences depending on the onset of inflammation. Likewise, liver fibrosis, a critical predisposition of liver cancer is a consequence of the deregulated activity of this pathway. Furthermore, we could show that IKK/NF-κB signaling is essential in a mouse model of pancreatic adenocarcinoma.

We are also interested in the gene regulatory networks governing development and differentiation of lymphoid subpopulations and their dysregulation in immune deficiency syndromes. Finally, a research team at the institute studies the molecular pathways associated with lymphoma development with a strong focus on classical Hodgkin's lymphoma.
Research Group: Neuronal Gene Expression

Head: Prof. Dr. Bernd Knöll

The research group of Prof. Dr. Bernd Knöll focuses on neuronal gene expression programs during normal as well as pathological nervous system function. We study gene regulatory processes exerted by transcription factors such as SRF (serum response factor) or ATF3 (activating transcription factor 3). During brain development, growing axons navigate towards their final targets in the brain to form functional neuronal networks. In this axon guidance process, we study how SRF interacts with the neuronal cytoskeleton (e.g. microfilaments) to induce changes of neuronal morphology allowing for directed axonal migration. In addition, we study whether gene regulatory processes are targeted by neurodegenerative disorders. For this, we use mouse models for neurological diseases such as epilepsy and multiple sclerosis. Finally, we attempt to apply SRF or ATF3-driven gene transcription to enhance the regeneration potential of transected nerve fibers during axonal regeneration.

Selected Publications:

Within the Institute we currently have 30 employees, 12 of whom are PhD students. 76.6 % of employees are female and 23.3 % have come from abroad.

We at the Institute of Biochemistry and Molecular Biology investigate the molecular basis of tissue and organ development during embryogenesis. We also want to learn more about how different tissues and organs are maintained during aging and how they regenerate after injury. To tackle these questions, we use different model organisms such as the mouse *Mus musculus*, the frog *Xenopus laevis*, the fish *Danio rerio*, the fly *Drosophila melanogaster* as well as murine embryonic stem cells.

Several groups within the institute study heart development (Kühl, Pandur and Philipp labs). The heart is the first functional organ during vertebrate development. Defects during cardiac development result in congenital heart diseases occurring in approximately 1% of all newborns and are estimated to be the cause of 10% of stillbirths and spontaneous abortions. Defects in regulatory molecules that function in early heart development have been linked to congenital cardiovascular malformation. Detailed analyses of normal heart development at the molecular level will help us to understand the pathological changes that occur in congenital heart diseases. Moreover, the recent identification of adult cardiac stem cells that can differentiate into functional heart muscle cells

Zebrafish can fully regenerate their hearts after injury. Histological staining of heart sections at seven days post amputation of the apex of the ventricle shows fibrin-rich wound tissue in red, and resolution of the wound and absence of a collagen-rich scar, which stains blue, at 30 days post amputation.
opens up a new perspective in the long term therapy of heart diseases and reinforces the need to understand the process of normal cardiac development. For similar reasons we study pronephros development in *Xenopus*. The pronephros represents the functional embryonic kidney in this species.

Another focus of the institute is to uncover cellular and molecular mechanisms underlying the elevated regenerative capacity of lower vertebrates. In contrast to mammals, fish and many amphibians can completely restore many internal organs and their appendages after injury. A detailed understanding of the mechanisms regulating this naturally occurring regeneration will aid in the development of regenerative therapies in humans. In the Weidinger lab we study heart and appendage regeneration in the zebrafish model. We focus on the role of extracellular signaling pathways, use systems biology approaches to uncover regulatory networks controlling regeneration and study the mechanisms inducing cellular plasticity during regeneration.

We also study molecular changes underlying the aging process using intestinal stem cells in *Drosophila* (Pandur lab) and hematopoetic stem cells in the mouse (Kühl lab) as model systems. Finally, the molecular design and the regulation of the Wnt signaling network, which controls many essential cellular processes during development, tissue homeostasis and regeneration, is analyzed by the Kühl and Weidinger labs. We use a combination of signaling assays in fish and frog embryos and cultured cells, biochemical approaches and mathematical modeling to uncover novel molecular regulators of this important signaling network. One important approach has been to use quantitative models based on ordinary differential equations and qualitative models in collaboration with bioinformaticians.
Institute of General Medicine

Head of Institute: Prof. Dr. Hans-Peter Zeitler
Keywords: general medicine | prevention | health support

The Institute of General Medicine regards itself as a link between clinical medicine and general medical practice activity.

Our team consists of a secretary, two full-time scientific employees, three part-time employees, 14 general practitioners employed as lecturers, and the director, who is also employed part-time while working for the remainder of his time in his own practice as a GP.

Demographic development has caused an increase in chronically ill and multi-morbid patients. The simultaneous shortage of young GP’s necessitates high-quality basic support offered by qualified and motivated family doctors. To do justice to this challenge we offer a family doctor tracking program in the first semester, whereby students are taught by an experienced GP as their tutor about the whole spectrum of their studies to define the reality of work and supply in General Medicine. Within the clinical semesters there is a course in General Medicine consisting of theme-based seminars and lectures in which examples of all important aspects of primary care activity are treated. In addition, there is a two-week traineeship in one of our teaching surgeries, in which the students can become familiar with various interesting features of General Medicine at first hand. Four months of the practical year (PJ) can thus be omitted.
Another focus of our teaching is prevention and health support. This course is conducted in collaboration with the Section of Sport and Rehabilitation Medicine. In addition to cross-institutional seminars and lectures, this course deals with structured theory as well as practical components, in which students can gain experience in applying prevention in different modules. To respond to this enormous challenge to both teaching and research within such a small department, we work together with more than 150 teaching and research practices.

The main emphasis of our research centers particularly on the study of the reality of supply and the decision-making processes in General Medicine. In addition to this, we are currently working on a project sponsored by the BMG to define ways of diagnosing rare illnesses within the context of primary health care.

Selected Publications:
Institute of the History, Philosophy and Ethics of Medicine

Acting Director of the Institute: PD Dr. Igor Polianski
Keywords: Clinical ethics | history of medicine | medical ethics | philosophy of medicine

Our institute is dedicated to research and education covering a wide spectrum of medical theory and practice: The history and ethics of medicine in addition to medical theory and the philosophy of science are topics that are vital for medical practitioners and the researchers of tomorrow. Furthermore, the institute coordinates and conducts a counseling service to tackle ethical questions in the fields of medicine and health care at the University Hospital.

The institute connects the history of medicine and the life sciences to modern dilemmas concerning philosophy, medical ethics and medical sociology. By exploring the social and cultural dimensions of medicine, this helps to bridge the gap between biomedical research, clinical practice and social issues as reflected in the humanities and social sciences. With a faculty covering various scientific backgrounds – medicine and the life sciences, cultural and historical anthropology, philosophy, political studies, history and sociology of science – the institute practices a truly transdisciplinary approach.

At the institute, medical students and students of molecular medicine are taught the historical, philosophical and ethical backgrounds of their field to enable them to cope adequately with the challenges of their later everyday professional life. Furthermore, the institute presents on-the-job training for physicians, nurses and other hospital staff.
Research at the institute includes a great variety of methods and topics such as international comparative studies in the history of medicine and biology, the origins of biomedicine, and the philosophy of science and medicine, while placing a special focus on medical ethics. Current projects include the shaping of medicine as a life science since the year 1900, the transfer of medical knowledge and scientific networks, classification and evolution in medical diagnostics and medical imaging, the ethics of stem cell research, and the development of clinical ethics from an intercultural perspective.

The institute also coordinates the University's Center of Medicine and Society. In the field of biomedical sciences, responsible future-oriented research will only happen by means of dialogue with contemporary society and by considering the basic historical, theoretical and ethical principles of medical research and action. In this respect, the center intends to offer an interdisciplinary and multiperspective approach. To achieve this, Ulm University with its record of intensive research provides the perfect setting and conditions. The Center of Medicine and Society is able to act as a showcase for biomedicine and the humanities, which deal with medical issues, and also serves as a platform for the life sciences by reflecting upon its own actions. The institute offers its expertise in the arts and humanities as well as the social sciences to act as an interpreter and promoter of interdisciplinary medical research.

The institute has established a reference library which houses a constantly expanding collection of specialized books and research literature. In addition, current journals on the history, philosophy and ethics of medicine are also available. The entire collection is listed in the online catalog of the University Library. Moreover, there is an index of newspaper articles concerning numerous scientific issues on the history, philosophy and ethics of medicine.

Public health poster from Spanish flu era, ca. 1918, Poster by Rensselaer County (New York) Tuberculosis Association. The figure shows a classical example of material that requires analysis from a cultural perspective. The understanding of current scientific discourses and public fears about the pandemics of today and tomorrow demand an analytical approach and the background of the history of medical knowledge and medical ethics.

Selected Publications:
Institute of Epidemiology and Medical Biometry
Head of Institute: Prof. Dr. Dietrich Rothenbacher, MPH
Keywords: cardiometabolic diseases | asthma and allergies | health in older adults | data management | statistical methodology

Since December 2010 the Institute of Epidemiology and the Institute of Medical Biometry have been combined. Thus, the expertise for the planning, conduct and analysis of population-based and clinical epidemiological studies, registries and randomized clinical studies is now concentrated in the institute.

The research profile includes asthma and allergic diseases as well as cardiovascular disease, metabolic disorders and cancer. Several large population-based studies are conducted as collaborative research projects. In 2012 a birth cohort study that includes over 1,000 families was
established (Ulmer SPATZ Gesundheitsstudie). Furthermore, the institute is the data center for many multi-center studies (e.g. ISAAC Phase II, GABRIEL) as well as for the prevention program for school-children “The Healthy Boat.”

The institute is also hosting several registries. In cooperation with the Department of Neurology the first clinical epidemiological register for amyotrophic lateral sclerosis (ALS) in Germany was implemented as well as several RCT’s. In addition, data from the international Huntington-registry EHDN are analyzed. Interdisciplinary geriatric research has also been successfully established at the institute (ActIFE-study).

Furthermore, the DPV (diabetes patient documentation), an electronic data-based documentation software for all forms of diabetes in both children and adults, is operated here (Prof. Holl). Moreover, research on statistical methodology in clinical studies is also conducted (Prof. Muche). The institute teaches students from several study programs and clinical researchers in epidemiology and biometry by means of lectures, seminars and a consultation service. In addition, an annual International Summer School of Epidemiology has been held for the past 25 years in cooperation with the Gillings School of Global Public Health at the University of North Carolina (UNC) in Chapel Hill (USA).

Selected Publications:
Conventional chemotherapeutic drugs failed to kill chemoresistant glioblastoma cells.


Institute of Forensic Medicine
Head of Institute: Prof. Dr. Erich Miltner
Keywords: D,L-Methadone | apoptosis | cancer | DNA-methylation | medical law

The Institute of Forensic Medicine has 35 employees and concentrates on three fields of work to perform all routine services: forensic medicine; forensic toxicology; and forensic genetics. Distinctive features include: the performance of CT-scans with scanner adjacent before routine autopsies; services in the DNA laboratory for DNA profiling of single skin scales after microscopical selection; heteroplasmy evaluation in mitochondrial DNA control region using pyrosequencing; and analysis of DNA-methylation in different human tumor tissues. Additionally, we conduct scientific work in medical law. In the molecular research laboratory, we focus on oncology in such areas as apoptosis, DNA-damage and cell cycle signaling of anticancer drugs, radiation and opioids, and the
development of new strategies for cancer treatment. We have discovered that D,L-methadone, which is commonly used to break addictions to opioid drugs, has the surprising power to kill and to sensitise for conventional therapies leukemia cells and solid tumors, including those in the treatment of resistant forms of cancer. This finding provides the basis for developing new strategies to establish D,L-methadone as an additional therapeutic anticancer drug and also for further investigations to combine D,L-methadone with chemotherapy or radiation to overcome chemo- and radioresistance in cancer in order to improve therapeutic success.

D,L-Methadone increased effectiveness of chemotherapeutic drugs in killing cancer cells.
Institute of Pathology

Head of Institute: Prof. Dr. Peter Möller
Keywords: Lymphoma research | Sarcoma research | Biomarkers in oncology | Dementia research | Diagnostic oncology

Profile of the Institute/Department (1,500 characters including spaces):
The Institute of Pathology is an integral part of the Medical Faculty of Ulm University and of the Comprehensive Cancer Center Ulm (CCCU). The institute runs four diagnostic laboratories, one of which comprises an accredited facility for diagnostic molecular pathology that is especially engaged in molecular oncology. The institute employs 63 personnel, most of whom are female and among whom five are board-certified pathologists and two are neuropathologists. We have four positions for medical residents in training. Further academics include two geneticists and one molecular biologist/biochemist. Currently, the department hosts two medical students working on their MD thesis and one of these recently received the Württembergischer Krebspreis (Württemberg Cancer Award) for young scientists.

The institute is primarily engaged in clinical and surgical pathology covering all disciplines of Ulm University Medical Center and smaller surrounding hospitals. The number of diagnosed patients amounts to more than 40,000 per year. The pathologists with board certificates are constitutive members of the weekly interdisciplinary tumor boards of the CCCU, of surrounding hospitals and those of the national Bone Tumor Working Group.

The head of the institute is one of six members of a panel of German reference pathologists specializing in lymph node and lymphoma pathology. This panel conducts reference pathology for clinical trials in childhood and adult Hodgkin and non-Hodgkin lymphoma and is engaged in trial-associated pathological and clinical research in lymphoma. The head was among the first to describe
mediastinal large B cell lymphoma. Other scientific topics of the institute include the generation and molecular and genetic characterization of novel cancer cell lines derived from a variety of cancers and the molecular characterization of tumor entities like leiomyosarcoma, liposarcoma and chordoma. Moreover, we are interested in the analyses of therapy-resistant prostate carcinoma. In clinical research, the focus is on the detection of prognostic biomarkers. The institute and the CCCU, together with its affiliated biobank, have cohorts of patients and their freshly frozen and paraffin-embedded tumor tissues for the following disease entities: classical Hodgkin lymphoma; gastric lymphoma; pancreatic ductal adenocarcinoma; leiomyosarcoma; and chordoma with clinical follow-up data spanning up to more than a decade.

The institute has a separate division of neuropathology that is headed by Prof. Dr. Dietmar Thal. His research focuses on Alzheimer’s disease and other related neurodegenerative disorders. This group introduced a staging system (“Thal phases”) for amyloid plaque pathology that has been incorporated into the current guidelines for the neuropathological diagnosis of Alzheimer’s disease by the National Institute of Aging and the Alzheimer’s Association. Current research projects focus on the discovery of Alzheimer’s disease initiation and propagation mechanisms and their relevance for therapeutic approaches.
Institute of Virology

Head of Institute: Prof. Dr. Thomas Mertens
Keywords: Diagnostic | Cytomegalovirus | Therapy | Resistance | Pathogenesis-Morphogenesis

The institute performs virological diagnostics for Ulm University Hospital as well as for some external senders. For the most part, these are highly specialized laboratory services based on specifically established and validated methods. One main focus is the monitoring of immunosuppressed patients, especially bone marrow transplant recipients in pediatric and adult medicine. This monitoring is decisive for the outcome of highly specialized therapies since these patients are often vitally threatened by exogenous and reactivated viral infections. Other foci are the diagnosis of respiratory infections as well as virus infections during pregnancy.

Research is focused on Human Cytomegalovirus (HCMV), a member of the herpes virus family. Teaching is provided for students studying human medicine, dentistry, biology and informatics as well as for bachelor and master students of courses in Molecular Medicine and students of the International Graduate School in Molecular Medicine.

In addition to two permanent professorships, the institute consists of six assistants and eight medical technicians. The majority of these work in the diagnostic section.

For many years, a close cooperation has been established with the universities of Padua and Bologna. Thus, there are always a number PhD students from Italy (see picture) as well as qualified PhDs working at the institute. With regards to research on CMV, there are various work groups focused on such topics as the mechanisms of HCMV resistance against existing antiviral substances. This work resulted in essential findings concerning CMV-coded proteins that have since been published in high ranking journals. Methods and procedures have been established and, at the end of 2009, a database was released enabling interested researchers using the worldwide web to correlate mutations in CMV genomes that confer resistance to corresponding resistance phenotypes. We have noticed that this website has been used extensively in recent months.

The director of the institute is the head of a network of the Robert Koch Institute focused on infections during pregnancy and immune suppression. This institute is a national reference laboratory for human CMV.
Another research group is working on the function of viral tegument proteins for the morphogenesis of CMV. This research was funded by a Schwerpunktprogramm (Priority Program) of the Deutsche Forschungsgemeinschaft (DFG), the German Research Foundation. This project has resulted in some understanding of the biology of this very complex virus and will also enable the identification of new targets for antiviral intervention. One research project focuses on the effects of CMV infection in monocytes and macrophages. A special aspect of this work is that these cells are central cells of the immune response and are not only infected but are obviously also used as sites of latent CMV infection. In this context, results showed that differentially polarized macrophages vary significantly concerning HCMV infection.

Finally, we are also studying the role of natural killer cells in the control of human cytomegalovirus infections. This research is based on in vitro models and also on materials from pediatric SCID patients.

In the field of CMV research, the modulation of cellular genes by viral gene expression is also examined. This aspect reveals special importance concerning research on human diseases which are not primarily classified as infectious diseases, e.g. atherosclerosis.

Concerning clinical virology, there is close cooperation with various clinical departments and institutes focusing on research dealing with different viral infections.

Selected Publications:
Institute of Molecular Virology
Head of Institute: Prof. Dr. Frank Kirchhoff
Keywords: Accessory viral proteins | AIDS | HIV | immune evasion | SIV

The Institute of Molecular Virology was established in Spring 2009 and has currently 30 members including five scientists, six research technicians, 13 PhD students, four master students and two secretaries. Two employees come from India and South Africa respectively.

One particular research interest is to determine which factors contribute to the high virulence and effective spread of HIV-1. Four groups of HIV-1 (M, N, O and P) have been described and each one is the result of an independent transmission of a simian immunodeficiency virus (SIV) from apes to humans. We found that better adaptation to a human host may explain why only HIV-1 groups M (major) and O (outlier) have spread significantly in the human population. A deletion in the human version of the restriction factor “tetherin” that inhibits the release of HIV particles confers resistance to the viral Nef protein used by most simian immunodeficiency viruses to antagonize this antiviral factor. Pandemic HIV-1 group M cleared this hurdle by acquiring the ability to utilize the viral protein U (Vpu) to counteract tetherin. In contrast, the Nef proteins of epidemic HIV-1 group O strains evolved to target a region adjacent to this deletion to keep tetherin away from the cell surface. Thus, acquisition of anti-tetherin activity was most likely a prerequisite for the spread of the AIDS pandemic. Furthermore, our results suggest that differences in Nef function help to explain why HIV-1 causes AIDS, whereas monkeys that are naturally infected with SIV do not develop the disease.

Nanofibrils boost retroviral transduction. Analysis of HeLa cells (blue) inoculated with either MLV-YFP (green) alone or in the presence of nanofibrils. Adapted from Yolamanova et al., Nature Nanotechnology 2013.
Another interest are endogenous factors that modulate viral infections. In cooperative studies, we screened complex peptide libraries from human sources to identify novel inhibitors and enhancers of HIV-1 infection. We identified a naturally occurring HIV-1 entry inhibitor and demonstrated that an optimized derivative thereof is safe and effective against HIV-1 in a first clinical trial. Strikingly, our analyses also showed that semen contains amyloid fibrils that boost HIV-1 infection. Based on this discovery, we developed fibril-forming peptides that improve retroviral gene transfer. Recently, we identified a natural CXCR4 antagonist that not only blocks infection by CXCR4-tropic HIV-1 strains but also promotes the mobilization of stem cells, suppresses the migration of cancer cells and exerts anti-inflammatory effects in mouse models. This CXCR4 antagonist is generated from a highly abundant precursor at sites of infection or inflammation and may thus introduce a new concept in the regulation of the activity of G protein-coupled receptors. Our results show that screening of complex peptide libraries derived from human sources allows the discovery of agents with highly unexpected activities that have implications beyond HIV/AIDS.
In September 2013, Prof. Jumaa (formerly of the Max-Planck Institute of Immunobiology and Epigenetics, Freiburg) was appointed as the new director of the institute to succeed Prof. Rodewald, who moved to the DKFZ/Heidelberg in 2010, and Prof. Fehling, who served as interim director. The institute currently accommodates two research groups headed by Prof. Jumaa and Prof. Fehling. A central topic of the Jumaa research group is the characterization of B cell antigen receptor (BCR) signaling in the development and proliferation of normal B cells as compared with transformed cells. In our previous work, we established a unique in vitro experimental system that allows us to dissect the signaling cascades that act downstream of the BCR. Using this system, we also investigate the mechanisms that trigger BCR signaling in B cell lymphomas and may be involved in the pathogenesis of human lymphoproliferative diseases. Moreover, we investigate the oncogenic potential of BCR-associated signaling proteins such as the tyrosine kinase Syk. To this end, we have established animal models for inducible expression of Syk variants that were isolated from human lymphomas.
The generation and analysis of genetically modified mouse strains define the prime technical expertise of the Fehling research group. The laboratory currently focuses on two key topics. One set of projects aims at a better molecular understanding of the (patho-) physiological function of “Mixed-Lineage-Leukemia 5,” a gene encoding an epigenetic regulator and suspected tumor suppressor of human myeloid leukemias. MLL5-deficient mice generated in the laboratory have revealed key roles of this protein in normal hematopoietic stem cell function and may provide a valuable animal model for investigating potential contributions of MLL5 to leukemogenesis. In another line of investigation, the Fehling group has generated several sophisticated “knock-in” mouse strains to directly visualize developmental fate decisions in the hematopoietic system using techniques of in vivo lineage tracing. This project has recently provided important novel insights into early T lymphopoiesis (J.Exp.Med. 2013).
Institute of Medical Microbiology and Hospital Hygiene

Head of Institute: Prof. Dr. Steffen Stenger

Keywords: Bacterial immune escape mechanisms | disease infection immunology | infection epidemiology | intracellular pathogens | microbial pathogenesis

The Institute of Medical Microbiology and Hospital Hygiene is responsible for the diagnosis of microbial infections in a broad spectrum of clinical samples. Each year about 60,000 materials are investigated for the presence of bacteria, fungi and parasites. In addition to its activities as a clinical diagnostic laboratory, the hospital hygiene section (headed by Prof. Dr. Heike von Baum) is responsible for the hygiene management of the university clinic.

Teaching activities include lectures and practical courses for students of the Medical School, the Dental School, and bachelor and master students of Molecular Medicine. Traditional lectures are supplemented by more interactive teaching in problem-oriented learning (POL) courses and e-learning programs.

The scientific activity of the institute is covered by four independent research groups specializing in various aspects of infectious diseases which entail basic science as well as more clinically-oriented research.

Research Group: Infection Epidemiology

Head: Prof. Dr. Heike von Baum

This group is focusing on infection epidemiology of methicillin resistant S. aureus strains (MRSA), pathogens in drinking water and community acquired pneumonia.
Research Group: Chlamydia
Head: Prof. Dr. Andreas Essig
The research activities are centered on the intracellular pathogens *Chlamydia pneumoniae, Chlamydia trachomatis* and *Chlamydia abortus*. Current projects of the group are aimed at the identification of antigenic surface structures of chlamydia that could serve as diagnostic markers in serological investigations.

Research Group: Streptococcal Research
Head: Prof. Dr. Barbara Spellerberg
The focus of the streptococcal research group lies in the elucidation of streptococcal virulence factors and immune escape mechanisms. Research topics include the identification of streptococcal virulence determinants and the detailed characterization of host-pathogen interactions.

Research Group: MyTB Laboratory
Head: Prof. Dr. Steffen Stenger
This group focuses on the immunological mechanisms directed against mycobacteria. The major goal of the group is the analysis of innate and adaptive effector pathways of the human immune system.

Scientific highlights of our institute in recent years have included the elucidation of molecular host pathogen mechanisms in the interaction of mycobacteria and streptococci with human macrophages. Further research characterized the antibody responses to *Chlamydia abortus* infections and has resulted in an epidemiological study about the outcome of influenza-associated pneumonia.

Selected Publications:
The Institute of Human Genetics offers diagnostic genetic analyses as well as genetic counseling for patients and their relatives. The research teams working at the institute are investigating different research topics including the analysis of the causes of complex and monogenic disorders, the mutational mechanisms underlying human genomic rearrangements as well as the mechanisms of mutagen-induced DNA damage and its repair.

The diagnostic laboratory at the institute is state-certified and performs prenatal and postnatal chromosome analysis including G-banded karyotyping and fluorescence in situ hybridization (FISH). Furthermore, molecular genetic testing is performed for approximately 60 genes with a focus on neurogenetic diseases and hereditary cancer predisposition by means of DNA sequence analysis, multiplex ligation-dependent probe amplification (MLPA) and Southern blotting. A next generation sequencing (NGS) platform will be implemented in routine diagnostics in 2014.

Genetic counseling is offered in our outpatient clinics by medical geneticists. Moreover, a genetic consultation service is provided for other clinical departments of the University Hospital, e.g. the Children's Hospital and the Department of Neurology. We also collaborate with the Department of Obstetrics and Gynecology in the areas of hereditary breast and ovarian cancer and prenatal diagnosis.

The Institute provides comprehensive teaching of the basics of molecular and clinical genetics for students of medicine, molecular medicine, and biology. By means of lectures, interactive seminars and practical courses performed at the Institute we aim to convey the knowledge...
The picture shows a human cell in the comet assay. Induced DNA damage leads to migration of DNA out of the nucleus and to the formation of a “comet” consisting of a head (nucleus) and a tail (DNA that has migrated out of the nucleus). The amount of tail DNA is proportional to the DNA damage.

The Institute of Human Genetics, located at Ulm University, offers a comprehensive program that integrates modern medical and molecular genetics to our students in a vivid manner. We are part of the International Graduate School in Molecular Medicine Ulm and offer MD and PhD projects as well as specializations in genetic diagnostics and clinical genetics for scientists and medical doctors. Basic and applied genetic research is performed by five independent research teams working on different topics that are important in human and medical genetics. These research topics include: (i) disease gene identification in monogenic and complex genetic human diseases by genome-wide approaches including linkage analysis and exome sequencing; (ii) analysis of DNA damage and DNA repair induced by environmental mutagens using genotoxicity tests such as the comet assay and the micronucleus test and gene expression profiling; (iii) mechanisms underlying large genomic rearrangements including microdeletion and microduplication syndromes using neurofibromatosis as a model disease, (iv) genetic epidemiology and cancer genetics; (v) molecular mechanisms of genomic variation, in particular, structural variation which predisposes to human disease. All research groups are continuously funded by national and international funding agencies and publish their results in internationally renowned and peer-reviewed scientific journals attesting to the quality of their research projects.

Selected Publications:
Institute of Pharmacology and Toxicology
Head of Institute: Prof. Dr. Peter Gierschik
Keywords: Bacterial protein toxins | chemokine receptors | GTP-binding proteins | Rho GTPases | Phospholipases C | Signal transduction

Our primary and long-term mission is to advance the field of Molecular and Cellular Pharmacology and Toxicology in research, teaching and application. Our research efforts are directed at addressing fundamental scientific questions by conducting basic research and at translating basic research findings into sustainable health care improvements by cooperating with the pharmaceutical industry. Our research focus is centered on exploring the transfer of extracellular information of both abstract and concrete essence across the cell membrane. According to the broad and deep impact of pharmacology and toxicology in medicine and the life sciences, the scope of our teaching activities is wide and multidisciplinary, and ranges from medicine, dentistry and molecular medicine to biology, biochemistry, chemistry and pharmaceutical biotechnology. Teaching is conducted at under- and postgraduate levels and in collaboration with the pharmaceutical industry on such topics as national and international (EU) principles of new drug development, registration, and post-marketing risk assessment.

Several research groups are concerned with the role of signal-transducing GTP-binding proteins (both heterotrimeric G proteins, small GTPases of the Ras superfamily) as well as their cell surface receptors, intracellular regulatory proteins and effectors in cellular signal transduction. Among the G-protein-coupled-receptors, PD Dr. Barbara Moepps is particularly interested in chemokine receptors, which play pivotal and indispensable roles in health and disease by controlling multiple aspects of many cell and tissue functions. Among the small GTPases and intracellular effector proteins, the focus is on Rho GTPases and inositol-phospholipid-specific phospholipases C (PLCs), respectively. In collaboration with other research groups we have determined the three-dimensional
structure and characterized the functional properties of the heterodimeric complexes between certain Rac GTPases with their regulatory and effector proteins, such as PLCγ. The latter interaction has recently been shown by the group of Dr. Claudia Walliser to be involved in the development of tumor cell resistance to targeted small molecule therapy.

The institute’s research group devoted to toxicological research and health concerns is headed by Prof. Holger Barth and uses biochemical, molecular pharmacological, and cell biological methods to characterize the molecular mechanisms of action of bacterial protein toxins, including diptheria, pertussis, anthrax, and clostridial toxins. The specific interest is in the transfer of these toxins across cell membranes and their refolding into active biomolecules inside the cell. In collaboration with other research groups, novel pharmacological inhibitors of toxin transport across cell membranes were identified and characterized. It is expected that these findings will not only contribute broadly to our understanding of the impact of these toxins as virulence factors, but will also provide new avenues for the drug therapy of bacterial infections.
Institute of Naturopathic Medicine and Clinical Pharmacology

Head of Institute: Prof. Dr. Thomas Simmet
Keywords: Chemistry of natural products | nanomaterials | immunopharmacology | pharmacogenomics | pharmacology of natural products | signal transduction

The institute is located at Science Park I of Ulm University. Our Institute has 17 employees: 67% are female and 12.5% come from abroad. Six graduate students are currently attending our PhD program. We teach clinical and basic pharmacology to medical and basic sciences students. The institute maintains a strong research profile using state-of-the-art equipment designed for demanding research projects that are often conducted in collaboration with other research groups on the campus as well as from abroad.

Our research profile is somewhat unusual and, to some extent, is the result of a concept unique to Ulm that combines clinical pharmacology with pharmacology and chemistry of natural products. Accordingly, the institute is subdivided into several research groups: chemistry and pharmacology of natural products; biochemical and immunopharmacology combined with protein chemistry, chemistry, pharmacology and toxicology of nanomaterials; and pharmacogenomics.

With respect to pharmacology of natural products, we isolate and characterize natural compounds with the goal of identifying lead compounds for the therapeutic modulation of signal transduction mechanisms in inflammation and cancer. We possess considerable expertise in the molecular characterization of small molecule-protein interactions by means of surface plasmon resonance analysis. Highly sensitive analytical methods allow us to analyze pharmacokinetics in minute amounts of plasma, e.g. in the circulation of chicken embryos.

Molecular pharmacological and biochemical studies are aimed at the elucidation of proteolytic signal transduction mechanisms in cells engaged in chronic inflammatory processes, which are the most frequent reasons for patients seeking medical treatment.
Nanomaterials offer a great range of opportunities. More recent studies in our institute were aimed at the characterization of the nano-bio interface. The insight obtained from those experiments was used to develop novel nanomaterials with exceptional and precisely defined physicochemical properties. We are currently exploring their potential therapeutic application in cancer treatment. Moreover, special nanomaterials have been designed and synthesized that might allow remote modulation of cell functions by external physical forces.

The group working on immunopharmacological topics deals primarily with the complement system as an effector of the innate immune system. The goal is to develop new immunological applications, e.g. novel complement inhibitors by protein biochemical and biopharmaceutical approaches. Accordingly, the methodology includes engineering and production of recombinant proteins as well as the testing of promising immunomodulatory biopharmaceutical candidates in terms of protein-protein and protein-cell interactions by employing state-of-the-art technologies.

The central research topic of the Clinical Pharmacology group of the institute (Prof. Dr. Oliver Zolk) is the identification of (genetic) markers, which allow prediction of “responder” and “non-responder” to a given pharmacotherapy. Marked differences are frequently observed in the treatment effects between individual patients that may lead to treatment failure or undesirable side-effects. Unlike standard therapy (“one-size-fits-all”), personalized therapy aims at identifying clinically relevant subpopulations of patients for a targeted treatment. Genetic, molecular or cellular markers are the basis for the selection of patients suitable for a specific therapy. We apply pharmacogenetic tests and advise physicians to adapt the therapy to the individual variations in the genetic profile of the patients.

Selected Publications:
Institute of Experimental Cancer Research

Head of Institute: Prof. Dr. Christian Buske

Keywords: Leukemia | stem cell biology | lymphoma | WM | MZL

As a clinical institute of the Comprehensive Cancer Center Ulm (CCCU), our central goal is to advance translational research in tumor biology and to act as a bridge between research institutes of the university and the clinical departments of the university hospital. The focus of our research lies in the mechanisms of tumorigenesis by using acute leukemias as a model disease of cancer. Another focus of the institute is clinical lymphoma research. The institute coordinates the newly founded “European Consortium for Waldenström’s macroglobulinemia” (ECWM) and the national registry for marginal zone lymphoma in Germany that is funded by Deutsche Krebshilfe (German Cancer Aid).

Translational Research

Functional Analysis of Genetic Alterations in Acute Leukemia

We try to understand the mechanisms through which leukemia-specific genetic aberrations convert normal hematopoietic cells to leukemic cells by using appropriate mouse models mimicking human AML. The institute is particularly interested in leukemias induced by the AML1-ETO fusion gene, the NPM1 mutation or leukemogenic HOX genes, which are all aberrations found in patients with acute myeloid leukemia.

Importance of Non-coding RNA for Normal and Malignant Hematopoiesis

A further focus of our institute is to dissect the function of non-coding RNA molecules (RNA that do not encode proteins) in normal and malignant hematopoiesis. Using different in vivo models, our group aims to identify crucial differences in the expression of non-coding RNAs between healthy and leukemic stem cells and to clarify which microRNA acts as an oncogene and which one acts as a tumor suppressor gene.

Identification of Tumor Stem Cells

Another major focus of the institute lies in the characterization of leukemic stem cells and to define differences between healthy and leukemic stem cells. This would allow the development of therapeutic approaches which selectively kill leukemic stem cells.

Figure 1: Gene expression signature of functionally validated leukemic stem cells isolated from patients with acute myeloid leukemia correlates with treatment outcome in patients with normal karyotype AML. LSC = leukemic stem cell.
Characterization of Stem Cell Regulating Factors
The understanding of normal blood hematopoiesis is the basis for our understanding of malignantly transformed hematopoiesis. Hence, several projects deal with the question of determining which factors are crucial for the function of normal blood stem cells (Figure 1).

Clinical Research

Waldenström’s Macroglobulinemia (WM)
The institute coordinates the “European Consortium for Waldenström’s Macroglobulinemia” (ECWM) (www.ecwm.eu/), a European consortium in which all major study groups in Europe participate. The consortium initiated a large academic phase III trial to test the efficacy of Bortezomib in the first line of treatment of patients with WM (PI: Prof. C. Buske; sponsored by Ulm University Hospital).

Marginal Zone Lymphoma (MZL)
In 2014 the institute will open a national registry for marginal zone lymphoma. This registry aims at collecting data about the treatment and therapy outcome of patients suffering from MZL in Germany and is funded by Deutsche Krebshilfe (German Cancer Aid).

Early Trials Network (ETN)
The head of the institute is the speaker of the ETN, which is a network of university hospitals in Germany, supporting the initiation of early clinical trials in B-cell lymphomas (www.unimedizin-mainz.de/early-trials-network/overview.html).
Institute of Research in Rehabilitation Medicine at Ulm University

Head of Institute: Prof. Dr. Gert Krischak, MBA
Keywords: rehabilitation | health service evaluation | clinical research | administrative data | physical therapy

The Research Association for Rehabilitation Science Ulm focuses on the different phases of rehabilitation in Germany and the interdisciplinary points of intersection. The Institute of Research in Rehabilitation Medicine at Ulm University is a member of this research association and is located in Bad Buchau. It has 11 members who receive most of their funding from third parties. Research activities focus on several aspects of rehabilitation and prevention. Our core task is practice-oriented research and the transmission of the results to health care institutions.
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Our institute has three main fields of research:

Firstly, the health service research of Dr. biol.-hum. R. Kaluscha and the health service evaluation of S. Jankowiak, M.Sc. Public Health, analyze health processes and pilot projects in rehabilitation for effectiveness and feasibility. Moreover, they evaluate the results of medical and occupational rehabilitation to determine treatments. These can be used to make the rehabilitation more demand-actuated. The emphasis of many projects is the analysis of the administrative date of health and pension insurance.

Secondly, the clinical research of Dipl. Physioth. L. Tepohl, M.A., serves to create and evaluate different rehabilitation concepts. Furthermore, a clinical study within the development of a self-adapting treatment for continuous passive motion has just been initiated.

A third project of this team is a virtual reality study on the ability to train the fine motor movement control of the cervical spine for patients with chronic neck pain.

Selected Publications:
Department of Internal Medicine I
Head of Department: Prof. Dr. Thomas Seufferlein
Keywords: Gastroenterology | gastrointestinal oncology | hepatology | pancreatic diseases | endoscopy | nephrology | endocrine diseases

Our department specializes in the diagnosis and treatment of patients with diseases of the GI tract such as gastrointestinal tumors (including neuroendocrine tumors of the GI tract), diseases of the liver, inflammatory bowel disease, endocrine disorders and diabetes, as well as acute and chronic kidney diseases. A special focus is centered on all diagnostic and therapeutic endoscopic procedures and transcutaneous as well as endoscopic ultrasound.

The department has 160 employees comprising 50 MDs and scientists, and 110 nurses and technical staff. We take care of four wards in Internal Medicine with 98 beds and are responsible for the Emergency Room of the Center for Internal Medicine. The department runs specialized outpatient clinics for GI oncology, IBD, hepatology, endoscopy, endocrine diseases, diabetes and nephrology including renal transplantation. More than 4,400 inpatients and 14,000 outpatients are treated in the department each year.

Our scientific focus in basic science is on gastrointestinal carcinogenesis and tumor promotion, particularly in pancreatic and liver cancer. We investigate the basic mechanisms of metastasis and protein transport, stem cell biology, and the immunological basis of type I diabetes. In translational and clinical research we run biomarker programs in several entities and aim at establishing novel means to monitor drug-induced tumor evolution in patients. Clinical trials are run in all clinical areas of the department (GI oncology, IBD, hepatology, endocrinology, nephrology). More than 50 national
and international phase I-IV trials are currently active in our Clinical Trials Unit. Several are being led by investigators of our department.

We receive national and international grants and participate in numerous national and international research collaborations. In the field of GI oncology the department is part of the Comprehensive Cancer Center Ulm (CCCU) and all patients are assessed by a multidisciplinary team. The Interdisciplinary Bowel Cancer Center, which is led by the department, was the second of these centers certified by the German Cancer Society. We closely cooperate with colleagues from surrounding community hospitals and general practices.

Our therapeutic standards follow national and international guidelines and the department actively contributes to the formulation of many of these guidelines.

Selected Publications:


Department of Internal Medicine II

Head of Department: Prof. Dr. Wolfgang Rottbauer

Keywords: Basic vascular and myocardial research | innovative cardiovascular imaging | interventional cardiovascular medicine

The department comprises the divisions of Cardiology, Angiology, Intensive Care Medicine, and two subdivisions: Pneumology (Head: PD Dr. Schumann, since April 1, 2014, Dr. Kropf-Sanchen) and Sports and Rehabilitation Medicine (Head: Prof. Dr. Steinacker). It represents these areas in inpatient and outpatient care, clinical and basic research, and in teaching and medical education (86 regular ward beds, five beds for monitoring sleep disorders, 52 telemetry options and 12 ICU beds). There are currently 49 full-time physicians, two physicists, 29 technical assistants and data managers who mainly work in the clinical routine. In addition, there are 11 technical assistants and six study nurses, both part-time and full-time, employed in clinical and basic research. Currently, there are 15 PhD students trained in the different scientific research groups.

The Cardiology and Angiology Division offers the whole spectrum of modern non-invasive and invasive diagnostic and interventional procedures. In the four cath labs, besides routine and emergency percutaneous interventions on coronary and peripheral arteries, including renal and carotid arteries, complex interventional procedures, such as revascularization of chronic total occlusions, percutaneous aortic valve replacement and mitral repair as well as occlusion of patent foramen ovale or atrial/ventricular septal defects, are routinely provided. The electrophysiology group implants approximately 300 pacemakers and ICDs annually and in addition appr. 80 CRTs. In the electrophysiology suite, about 300 radiofrequency ablations of supraventricular and ventricular tachycardias are annually performed. The department houses two cardiac MRI scanners (1.5 Tesla and 3.0 Tesla) and performs about 2,000 cardiovascular scans annually. In the Pneumology Subdivision, all modern diagnostic and interventional techniques as well as innovative therapeutic strategies have been implemented for the treatment of lung diseases, especially lung cancer. The Sports and Rehabilitation Medicine Subdivision offers outpatient clinics for a variety of sports disciplines and supervises many athletes and national teams. In addition, it offers ambulatory cardiac rehabilitation, in particular, post-myocardial infarction and post-cardiovascular surgery.
The zebrafish, Danio rerio, is an excellent model organism to study the genetic and molecular underpinnings of cardiovascular diseases using functional genomics approaches.

The department runs the core facility for small animal imaging of the Medical Faculty. Here, cutting edge MRI and µCT imaging and spectroscopy capabilities are provided for non-invasive assessment of disease stages in small animals.

Biomedical research is embedded in national and international research networks and consortia, and focuses on vascular pathologies and diseases of the heart muscle, including cardiomyopathies and arrhythmias, and, in particular, on the related genetic etiology and molecular pathophysiology. Large scale population-based genome-wide association studies as well as genomics and metabolomics of myocardial infarction and, in particular, of inflammatory processes are also covered. State-of-the-art functional genomics approaches in animal models, such as mice and zebrafish, have been established to study particularly the molecular basis of heart development and regeneration. Furthermore, animal models, such as LDL-receptor knock-out mice, apoE deficient mice as well as murine acute myocardial infarction models, are well established in the research department.

Clinical research is coordinated by a clinical trial unit that allows recruitment and monitoring of large patient cohorts in innovative trials with novel cardiometabolic compounds according to FDA or EMEA standards. Our preventive cardiology program focuses on the identification and evaluation of new biomarkers for cardiometabolic diseases. The experimental cardiovascular imaging group, comprising MR scientists and clinical MR experts, concentrates on the assessment of the role of MRI for the diagnosis of cardiovascular diseases. Techniques for tissue characterization and new approaches for the early identification and quantification of the significance of myocardial ischemia and myocardial motion abnormalities have been developed and are evaluated for their clinical utility.

Selected Publications:

The Department of Internal Medicine III has its focus on the diagnosis and treatment of diseases in the fields of hematology, oncology, palliative care, rheumatology and infectious diseases. The department is one of the largest of its kind in Germany with 110 inpatient beds, outpatient facilities and over 250 employees involved in patient care, research, teaching and education.

Specialized clinical care is provided for patients with benign and malignant disorders of the hemato-lymphopoietic system (e.g. anemia, acute and chronic leukemias, myelodysplastic syndromes, myeloproliferative diseases, Hodgkin-/non-Hodgkin lymphomas, multiple myeloma, aplastic anemia) and of patients with various solid tumors (e.g. lung cancer, renal cell carcinoma, breast cancer, brain tumors, sarcomas, germ cell tumors). Solid tumor activities are coordinated in a dedicated Oncology Section. The spectrum of activities comprises all modern diagnostic and therapeutic approaches, such as conventional chemotherapies, innovative treatments with monoclonal antibodies, biologicals, molecular-targeted approaches with novel compounds, and bone marrow/peripheral blood stem cell transplantation. The transplant unit is among the most experienced in the world. Another focus of the department is on the treatment of patients with hemophilia and thrombophilia, and of patients with autoimmune/rheumatologic diseases. The Section of Infectious Diseases is focused on the treatment of a wide range of patients, in particular HIV/AIDS, tuberculosis, tropical diseases, and echinococcosis. It provides vaccination and consultation services for travelers to foreign countries. It is both a partner and leader of the Comprehensive Infectious Disease Centre (CIDC).

Research activities include basic scientific as well as translational aspects with a focus on the identification and characterization of molecular pathogenesis, and on the development of novel therapies. A wide spectrum of clinical trials is active and thus continuously offers access to
innovative treatments in hematology and oncology to ensure the highest quality of patient care.

Medical doctors and scientists from our department are nationally and internationally renowned for their research work. This was documented in 2013 by the publication of over 200 articles in various international scientific journals, the obtaining of more than seven million euros in external research grant funding, and by participation in the development of international guidelines.

A major structure to advance laboratory science is the SFB1074 (coordinating principal investigator: H. Döhner) entitled “Experimental models and clinical translation in leukemia” (see separate article and http://www.uni-ulm.de/en/einrichtungen/sfb-1074.html).

The Laboratory for Cytogenetic and Molecular Genetic Diagnostics is a central reference laboratory within a number of multicenter clinical trial groups, e.g. the German-Austrian AML Study Group (AMLSG), the German Myeloproliferative Neoplasms Group (MPNSG), the German CLL Study Group (GCLLSG) and the German Multiple Myeloma Study Group (DSMM), as well as within various international pharmaceutical industry-sponsored trials.

To promote clinical research, the department hosts a Clinical Trials Unit (CTU) with a team of highly trained medical doctors and oncology study nurses. About 100 clinical trials of phase I-II (early development of novel and promising anti-cancer agents) and of phase III (randomized treatment trials) are currently active. A large proportion of patients are treated within clinical trials to promote innovation and ensure the highest quality of patient care. The department is an active partner of the Comprehensive Cancer Center Ulm (CCCU).

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Selected Publications:


Institute of Transfusion Medicine

Head of Institute: Prof. Dr. Hubert Schrezenmeier
Keywords: Hemapoietic stem cells | mesenchymal stromal cells | molecular diagnostics | transfusion

The institute is supported by the German Red Cross Blood Transfusion Service Baden-Wuerttemberg-Hessia and acts in close collaboration with the Institute of Clinical Transfusion Medicine and Immunogenetics Ulm (IKT Ulm) as a joint venture of the German Red Cross Blood Donor Transfusion Baden-Wuerttemberg-Hessia and the University Hospital of Ulm.

Research activities focus on two fields:
- Molecular diagnostics in immunogenetics, blood group genotyping, and defects of hematopoiesis and the immune system,
- Advanced therapy medicinal products (ATMP): development of large-scale GMP grade selection, manipulation, and cell expansion for regenerative therapy and immunotherapy.

In the work group “Molecular Pathophysiology, Molecular Diagnostics and Experimental Transplantation” new disease-causing mutations and pathophysiology of severe inborn errors of the immune system and hematopoiesis have been deciphered. Methods are developed for gene repair with oligodeoxynucleotides in these disorders. Also pathophysiology of hemolytic disorders and acquired bone marrow failure syndromes is studied with the aim to improve outcome by treatments targeting the complement system or modulating the immune system.

The Department of Transplantation Immunology focuses on optimized donor-recipient matching in order to improve outcome after stem cell transplantation. Therefore, methods for sequenced-based typing of HLA-A, -B, -C and HLA-DRB1 and –DQB1, a CE-certified kit for efficient high throughput HLA-typing as well as methods for typing also non-classical HLA molecules and non-HLA gene polymorphisms have been developed. The impact of single and combined HLA allele mismatches, Null-alleles and non-classical HLA alleles or non-HLA-gene polymorphisms on outcome after allogeneic stem cell transplantation is analysed.
In the Department of Blood Group Serology and Immunohematology, the genetic basis of the RhD-negative and weak-D phenotype and many new variants in the Rhesus blood group system has been elucidated. Methods for blood group genotyping have been developed.

Activities in the Department of Stem Cells and Cellular Therapy include the collection of peripheral blood stem cells, selection of CD34-positive hematopoietic progenitor cells, lymphocyte depletion of stem cell preparations as well as preparations for adoptive immunotherapy (donor lymphocytes, opsonized lymphocytes, dendritic cells). A main area of research is the functional characterization and ex vivo expansion of mesenchymal stroma cells (MSC) for regenerative and immunomodulatory therapy. Different large-scale GMP-grade, xenogen-free protocols for efficient ex vivo expansion of MSC up to > 1 x 10^8 cells have been developed. Regulatory approval for use of these ATMPs has been obtained. Our GMP clean room is one production site within a European Network funded by the seventh Framework Program of the European Commission. In the REBORNE project, MSC are explored in clinical trials for their potential in bone healing in close cooperation with the Department of Trauma Surgery Research and Biomechanics, the Department of Orthopedic Trauma, Hand, Plastic and Reconstructive Surgery, and the Department of Internal Medicine II.

We also explore how MSC, non-classical granzyme B-expressing cells and regulatory B-cells modulate the immune system and might be used for immunotherapy.

The IKT Ulm delivers the whole range of blood products and stem cell preparations and the diagnostics in the field of transfusion and transplantation medicine (blood group typing, immunohematology, transplantation immunology) for the University Hospital of Ulm and many other medical facilities in Baden-Wuerttemberg.
The mission of the Department of Gene Therapy is to conduct high quality research and teaching in
different research aspects of somatic gene therapy, genetic vaccination, development of gene transfer
technologies and neurodegenerative diseases.
The development of novel vector technologies is the focus of current research activities and several
projects in the laboratory aim at increasing efficiency, specificity and safety of therapeutic gene
transfer.
Since viruses have evolved together with their hosts, they are by nature very efficient vehicles for
the delivery of nucleic acids into cells. By removing one or several essential viral genes, they are
converted to gene transfer vectors with improved safety. Using adenovirus as a well-characterized
model virus, several projects relate either to the improvement of adenovirus vectors or to their use in
different genetic and non-genetic diseases.

Overcoming gene therapy barriers
So far, in vivo gene therapy has been successful only in a small number of clinical studies and one of
the main reasons for this is the lack of efficient gene transfer in vivo due to the interaction of vector
particles with different barriers in blood and tissues. This problem is being addressed by several
projects.

For example, genetic and chemical modification of adenovirus vectors, alone or in combination, is
used to identify and to overcome barriers imposed by either cellular components in blood or tissues
(erythrocytes, platelets, macrophages) or non-cellular components (antibodies and plasma proteins)
which prevent efficient gene delivery to specific cell types.

Another focus of the laboratory is the development of oncolytic viruses for the treatment of solid
cancers and the testing of these vectors in improved models of pancreatic cancer. Oncolytic viruses
multiply within tumor cells and spread from cell to cell while destroying the tumor cells. These studies
take into account the complex composition of solid tumors that, in addition to neoplastic cells,
contain many other cell types, such as stromal cells and endothelial cells, and also an extracellular
matrix.
Genetic vaccination for very common infectious diseases

Genetic vaccination shows considerable potential as a solution to overcome the limitations of classical vaccines in diseases like AIDS, tuberculosis and malaria. However, neither the mechanisms of induction nor the persistence of adaptive immune responses are understood very well following genetic vaccination. Based on the observation that the immunogenicity of adenovirus vectors negatively influences T-cell responses raised against vaccine antigens, we perform experiments to better understand basic mechanisms of genetic vaccination with the ultimate goal of improving the immunogenicity of genetic vaccines.

Biotechnology: production of viral vectors

Several projects concern biotechnological topics.

One of our long-standing interests is the immortalization of primary human cells from amniotic fluid under well-defined conditions and documentation with the aim to generate cell lines for industrial production of viral and, in particular, adenoviral vectors in clinical quality.

In a different project we wish to develop an improved and scalable production system for vectors based on Adeno-Associated Virus (AAV). This vector type is currently used in many clinical studies for the treatment mainly of genetic diseases. However, current production systems are very cumbersome and improved systems for production at an industrial scale are urgently needed.

Basic research and model development in neurodegenerative diseases

Besides performing treatment-directed research, we also have a strong interest in studying basic aspects of the pathogenesis of two neurodegenerative disorders: Huntington’s disease (HD) and Parkinson’s disease (PD). For these diseases, there are either no (HD) or only symptomatic (PD) therapies available. In HD we try to better understand the function of the protein that, in the case of mutation in the corresponding gene, causes disease. In PD we are developing improved models mimicking the disease as a basis for the identification of drugs with improved activities.

Selected Publications:

Effect of CK1 specific inhibitor 17 on the subcellular localization of CK1δ and CK1ε in MEFs. Primary mouse fibroblasts (MEFs) were either untreated or treated for 12 hours with a CK1 specific inhibitor (compound 17). To detect CK1δ (green) and α/β-tubulin (red), fixed cells were incubated with specific primary antibodies and fluorescence-labeled secondary antibodies. DNA (blue) was stained with DAPI.

Department of General and Visceral Surgery

Head of Department: Prof. Dr. Doris Henne-Bruns

Keywords: Colorectal Cancer | Gastrointestinal Stroma Tumors | Gastric Cancer | Pancreatic Cancer | Surgical Oncology | Sepsis | Signal Transduction | Kinase inhibitors

The Department of General and Visceral Surgery employs 33 physicians for 76 patient beds that are appointed on two regular wards, a special ward for children, and a surgical intensive care unit. Our focus is on surgical oncology and all standard procedures of general, visceral and endocrine surgery are performed. Special fields of expertise are hepato-biliary, pancreatic and colorectal surgery. The department also includes a section in pediatric surgery (Dr. med. C. Leriche).

The research interests of the individual research groups (M. Kornmann, MD, U. Knippschild, PhD, A. Formentini, MD, S. Paschke, MD, N. Huber, MD, J. Lemke, MD) are mainly focused on malignant diseases, and especially on pancreatic, gastric and colorectal carcinoma, and GIST, with foci on the characterization of alterations in signal transduction pathways, the characterization of biophysical properties of tumor cells, the identification of new target molecules for drug development, and the validation of kinase inhibitors in vitro, cell cultures, and animal models. Furthermore, additional projects concentrate on the analysis of the influence of changes in the expression of adipocytokines on septic progression (A. Hillenbrand, MD, A.-M. Wolf, MD and U. Knippschild, PhD), and the role of obesity as a disturbing factor during regeneration of muscle injuries (U. Knippschild in co-operation with M. Wabitsch, Division of Pediatric Endocrinology and Diabetes, Department of Pediatrics and Adolescent Medicine, University of Ulm). Many of the projects are currently funded by the Deutsche Forschungsgemeinschaft (M. Kornmann, U. Knippschild), the Deutsche Krebshilfe (U. Knippschild), and the Forschungsförderung des Landes Baden-Württemberg (S. Paschke). In co-operation with the biotechnology company 4SC Discovery (Martinsried, Munich), several highly potent CK1 isoform specific inhibitors have been identified and characterized in vitro, in tissue culture and in animal...
models. So far, these results have led to several publications in international journals. Since the identified inhibitors exhibit a high therapeutical potential, they can be integrated into new therapy concepts for the treatment of cancer and neurodegenerative diseases in the near future.

At present, two postdocs (J. Bischof, and Pengfei Xu) are working in the laboratories. Furthermore, students from EU countries, China, Costa Rica and Cameroon are completing either an experimental Bachelor, Master, PhD or MD thesis. A variety of cell culture, molecular biological and biochemical methods as well as several different animal models (xenotransplantation and transgenic models) for breast, colon and pancreatic cancer have been established. Furthermore, high-throughput techniques are used to identify molecules influencing the activity of protein kinases. Another special feature of the department is the availability of a large tissue bank that includes tumor, normal and fat tissues as well as the clinical data of patients.

In addition to this basic and translational research, our department currently participates in clinical multicenter trials concerning colon and rectal cancer.

Gastrointestinal stromal tumor (GIST)
The Department of Orthopedic Trauma is the second oldest of its type in Germany. It performs an average of 6,500 surgical procedures per annum and treats some 35,000 outpatients. The department is run by the Medical Director (Chair of Trauma Surgery), ten senior consultants and 26 doctors (eight female registrars and interns). The Trauma Laboratory (Prof. Dr. M. Huber-Lang) includes two PhDs, six female technicians as well as several doctoral students.

The department also incorporates the Division of Hand and Plastic Surgery (Prof. Dr. M. Mentzel). The research focus of this division concentrates on the analysis of the functional movement of the hand. In order to evaluate motion patterns, a sensor glove has been developed in cooperation with the Department of Robotics and Computational Biology at the Technical University of Berlin. This model may improve handling of a myo-electric prosthesis of the hand or help evaluate the severity of injuries and ongoing rehabilitation (Figure 1).

The Trauma Laboratory is part of the Clinical Research Unit 200 (DFG) that focuses on the inflammatory response and coagulation disorders of patients with multiple injuries. In an experimental setting, ex vivo and in vivo models have been developed to simulate multiple injuries consisting of a simultaneous head injury, chest injury, femur fracture and soft tissue injury. The aim is to elucidate the sequelae of combined injuries and to identify major factors of complications and outcome. A current and future focus also investigates the role of major co-morbidities on the molecular danger response after trauma (Figure 2).

Within the European REBORNE project on stem cells and artificial bone substitutes, the department is part of a multicenter clinical evaluation of stem cell-loaded bone allograft in delayed fracture healing and has already enrolled patients.
The multicenter study ORCHID (“Open Reduction and Fixation versus Closed Reduction in Distal Radius Fractures in the Elderly”) investigated in a prospective, randomized and controlled multicenter trial, if surgical management with volar plating of intra-articular wrist fractures is superior to cast immobilization in elderly patients. The controversial results in 187 randomized patients showed that surgical management with volar plating is not significantly superior to cast immobilization in terms of health-related quality of life outcomes.

The department covers every type of fracture care by using the latest implant technologies. As a Level I trauma center, the department is part of the German Trauma Network (DGU) and has been given a rating with the highest level of trauma care (SAV Hospital DGUV). Spinal surgery is performed using 3D computer guidance, a new technology that has been clinically evaluated in recent years in the department and realized as a high-end OR. This Hybrid OR at Ulm University Hospital combines a traditional OR with a 3D robotic imaging system in combination with an integrated interface to a navigation system and complete table integration. This unique high-precision imaging in the OR may take trauma surgery to another level. Special expertise allows treatment of bone and soft tissue tumors (on average 100 cases per annum). To achieve the best individual therapy for rare tumors, each case is discussed at the CCCU.

A further specialty is the analysis of leg deformities and correction that includes intraoperative computer guidance. Posttraumatic or degenerative joint destruction is treated by replacement of the joint where, in terms of knee joint replacement, computer guidance is also used.

Selected Publications:

The clinical focus of our department is keyhole surgery and percutaneous techniques as applied in a variety of heart, lung and vascular diseases. Videoscopic techniques enable mitral and tricuspid valve repair while keeping the breastbone intact. Catheter-guided percutaneous procedures are carried out in a cutting-edge hybrid suite and allow for less invasive implantation of aortic valve bioprostheses and vascular stentgrafts. Most pulmonary lesions are fixed either through videoscopy or less invasive incisions.

Key aspects of our clinical research are minimally invasive heart valve therapy, management of heart-lung machine, and alternative treatment methods of end-stage heart failure. In 2013 our department was the first center worldwide that was able to implant all catheter-based heart valves available at the time. Establishing scientific cooperation with imaging- and technology-related developers will help provide our patients with tailored treatment options in the future. Minimizing extracorporeal circuit, implementation of pulsatile perfusion and optimization of anticoagulation are subject to randomized clinical trials initiated by our department. A controlled world-wide trial investigating the effects of biopolymer injection into the failing heart has been initiated with the participation of four German centers, one of which is Ulm University.
Applying scientific techniques of regenerative medicine to cure cardiovascular diseases is the main focus of our basic research team. In a joint project with the Department of Transfusion Medicine, the interactions between bone-marrow mesenchymal stem cells and cardiomyocytes are studied to identify signaling pathways relevant for treating myocardial ischemia and heart failure.

We study the effects of combination therapies of established and novel vasodilators in an ex vivo model of pulmonary arterial hypertension as part of a multicenter program.

In an effort to bundle individual teaching activities centered on clinically related topics, we have introduced an interdisciplinary student course focusing on organ systems (heart, lung, blood vessels). This voluntary teaching track is offered to highly motivated students with a special interest in thoracic and cardiovascular medicine.

Selected Publications:


Division of Cardiac Anesthesiology

Head of Division: PD Dr. Helmut Reinelt
Keywords: Cardiac anesthesiology | cardiac intensive care | teaching and medical education

With the maximum experience and expertise in cardiac anesthesia and cardiac intensive care, the 16 physicians of our department guarantee the highest level of patient care and patient safety. With our high degree of specialization and our explicit dedication to patients with heart diseases, and together with our expert knowledge in anesthesiology, hemodynamic monitoring and in specific hemodynamic therapy, we have become a leading, reliable and effective contributor to modern heart surgery.

In 2013, anesthesia was performed in more than 1,000 cardiac operations with and without extracorporeal circulation, including highly innovative minimally invasive procedures. Minimally invasive mitral valve repair operations, minimally invasive aortic valve replacements, minimalized extracorporeal circulation system use or MIDCAB procedures are examples for high-tech-operations demanding perfect interaction and well-rehearsed teamwork of cardiac surgeons, perfusionists and cardiac anesthetists.
In addition, we have cared for about 100 patients undergoing transaortic valve replacement (TAVI) therapy, the majority of whom had an extremely high risk profile. For this group of patients we are likewise able to offer anesthesiological care precisely suited to each patient’s personal needs as well as for the requirements of a patient’s health status, be it by performing general anesthesia or by safeguarding reliable analgesia in combination with a mild sedation.

Our ICU (12 beds) offers modern cardiac intensive care including intraaortic counterpulsation, continuous renal replacement and hemadsorption therapy as well as extracorporeal membrane oxygenation or right- and/or left-ventricular assist devices.

For patients of a cardiac ICU the subtle balance of their coagulation status is of the utmost importance and the members of our staff are well trained in using quick and near-patient coagulation diagnostic tools as well as differentiated point-of-care testing methods such as rotation thrombelastography or platelet function testing.

To stay in close professional contact with other ICU physicians we are an active member of the Baden-Württemberg ICU peer review program that has been created as a quality assurance program in this highly challenging field of medicine.

Highlighting our commitment to medical education, our specialists are involved in postgraduate courses in TEE, CRRT, coagulation and ultrasound. In undergraduate education our course entitled “Cardiac Anesthesia,” which focuses on hemodynamic monitoring and therapy for patients with heart diseases, represents one of the most favored and best evaluated courses in the elective course program of the Medical Faculty.

Selected Publications:
Department of Neurosurgery

Head of Department: Prof. Dr. Christian Rainer Wirtz

Keywords: Intraoperative Imaging | Neurooncology | Peripheral Nerve Surgery | Traumatic Brain Injury | Vascular Surgery | Plexus Surgery | Pediatric Neurosurgery

The Department of Neurosurgery at Ulm University is headed by Professor Wirtz and is now one of the largest neurosurgical units in Germany. Twelve neurosurgeons and 13 residents provide outpatient care to more than 9,000 patients from around the world and perform more than 3,500 neurosurgical procedures each year. The team that includes eight women and five members from abroad is proud to cooperate with colleagues in other disciplines to offer expertise in treating a wide range of neurological and neurosurgical conditions. They are aided by outstanding and highly-skilled support staff. Our team of neurosurgeons provides thorough examinations, diagnoses and treatments for brain, nerve, and spinal cord diseases and disorders in children and adults. Each patient is treated individually since physical, psychological and cultural differences may affect treatment choices.

The Department of Neurological Surgery at Ulm University has two locations, namely, Ulm (State of Baden-Württemberg) and Günzburg (Federal State of Bavaria) with a total of 99 beds that includes intensive and intermediate care as well as normal ward units for adults and children. Our facilities include cutting-edge equipment, i.e. modern surgical microscopes (including 5-ALA fluoromicroscopy and intraoperative infrared angiography), image-guided brain and spine navigation tools as well as monitoring techniques. Furthermore, we offer two of the most advanced neurosurgical theaters in Europe, the BrainSuite®, which combines state-of-the-art neuronavigation and intraoperative magnetic resonance technology (Magnetom Espree® 1.5 Tesla) in Günzburg and an intraoperative angiography hybrid OR (Artis Zeego (c)) in Ulm, for the benefit of patients with a variety of conditions.
Our physicians are leaders in their field and contribute to advancements in brain, spine, endovascular and operative neurovascular surgery, neurotraumatology, pediatric neurosurgery and peripheral nerve care. Our goal is to provide optimal care to patients with neurological disorders and to enhance it through the continuous incorporation of advancing scientific knowledge. Our research efforts in neurovascular surgery, neuronavigation and tumor biology aim to break new scientific grounds that are relevant to neurosurgical practice.

Focused on brain surgery, peripheral nerve surgery, cerebrovascular concepts as well as neurotraumatology, our resident teaching programs are designed to promote a profound understanding of neurological surgery and to inspire patient care by fostering technical and surgical skills and by encouraging scientific inquiry.

The daily neurosurgical routine includes the training of medical students with an emphasis on practical bedside teaching. Training is offered either as a standard part of a student’s curriculum or by individual appointment. We encourage students interested in the neurological and neurosurgical field to complete their dissertation in our department.
The Institute of Orthopedic Research and Biomechanics performs basic and translational research on the pathophysiology and treatment of musculoskeletal disorders. An interdisciplinary research team of 40 engineers, biologists, molecular biologists, physicians and veterinarians work closely together (four professors, seven postdocs, sixteen PhD students, eleven technicians, two employees from abroad; of these 68% are female).

Our scientific work focuses on five main fields: fracture healing and bone regeneration; biomaterials and tissue engineering; cell biology; and joint as well as spine biomechanics.

In the field of bone healing, the major goals are to increase the knowledge of the complex regeneration process itself and to improve the treatment of bone fractures. As bone regeneration significantly depends on mechanical factors, we are interested in the underlying mechanisms. Furthermore, we are interested in delayed healing associated with osteoporosis or inflammatory processes. We are currently a part of two DFG-funded research groups (FOR793, KFO200) dealing with the subjects of “Mechanisms in Fracture Healing and Bone Regeneration in Osteoporosis” and “Inflammatory Response after Musculoskeletal Trauma.”
There is an increasing demand for biomaterials to treat or replace injured or diseased tissues. In the biomaterial research group we investigate bone, ligament and intervertebral disc replacement materials with a focus on degradable materials since these increase the chances of a complete recovery. Several of our projects deal with the development of “smart,” that is, structurally or biologically functionalized materials that allow specific control of cell function.

The aim of the cell biology group is to investigate the mechanisms of mechanotransduction in cells of the musculoskeletal system since regeneration and remodeling are strictly influenced by mechanical load. The involved pathways are of great interest because they can be possible targets for therapeutic intervention in regenerative therapies. Furthermore, we also investigate the interaction of cells with biomaterials. In EU-funded projects, we focus on the investigation of cellular changes in intervertebral disc degeneration and regeneration strategies.

The focus of the joint biomechanics research group is related to clinically relevant issues of the large joints. Cruciate ligament and meniscus surgery as well as total joint arthroplasty are of special interest. Biomechanical in vitro tests, finite-element modeling and in vivo functionality testing of implants are part of the scope of our research group.

The spine research team applies state-of-the-art in vitro and in vivo methods as well as finite-element models for basic research regarding spine biomechanics to gain a better understanding of loading and motions of the spine. The goal is to develop methods of diagnosis and evaluate treatment procedures in addition to regenerative strategies to improve and test spinal implants for the surgical treatment of spinal injuries, disc degeneration, and osteoporotic fractures and deformities.

Actin ring formation, calcitonin receptor expression and osteoclast specific vacuolar proton pump subunit TCIRG1 expression of osteoclasts.
The Department of Anesthesiology employs a staff of 99 MDs (40 % female) and is in charge of the perioperative care of all surgical disciplines. In addition to the main clinical department responsible for patients from the Departments of Orthopedic, Trauma and Plastic Surgery, Vascular and Thoracic Surgery and Visceral Surgery, it comprises four clinical divisions: the Division of Special Anesthesiology (Head: PD Dr. med. Wolfram Schütz) responsible for the clinical care of ear, nose and throat, gynecology and obstetrics, ophthalmology and urology patients; the Division of Emergency Medicine (Head: Prof. Dr. med. Claus-Martin Muth) in charge of all emergency cases in the city of Ulm and surrounding districts; the Division of Operative Intensive Care (Head: PD Dr. med. Eberhard Barth) responsible for all surgical disciplines; and the Division of Pain Therapy (Head: PD Dr. med. Peter Steffen) which takes care of all perioperative pain management and chronic pain patients. Approximately 34,000 patients are treated each year. The department organizes the Medical School’s teaching in emergency medicine, anesthesia and perioperative care, disaster medicine and diving as well as hyperbaric medicine, and participates in numerous other courses in medicine and molecular medicine. In addition, it is responsible for the training of “standardized patients” by recruiting actors as well as employing the use of high-end patient-simulators, and thus has the largest teaching activity of all the clinical departments of the Medical Faculty. All student examinations are organized as Objective Structured Clinical Evaluations (OSCE).
The department comprises two research divisions:

1. Division of Experimental Anesthesiology (Head: Prof. Dr. rer. nat. Elisabeth Marion Schneider)

   The main scientific topics are single nucleotide polymorphisms, biomarker profiling, and the role of the nuclear transcription factor-kB in patients with sepsis and hemophagocytic diseases. Ion channel effects of anesthetics are evaluated using patch-clamp techniques.

2. Division of Pathophysiology and Process Development in Anesthesia (Head: Prof. Dr. med. Dr. h.c. Peter Radermacher)

   The main scientific topics are: the role of various gaseous mediators such as NO, CO, H2S, and O2 during circulatory shock of various etiologies; the pre-clinical evaluation of innovative treatments under these conditions; the quantification of whole body and organ-specific metabolic pathways using stable and non-radioactive labeled isotopes in blood and breath tests and the determination of the activity of the complexes of the mitochondrial respiratory chain under various conditions. For this purpose, unique porcine and murine “investigational intensive care units” have been established to allow clinically relevant experimental models. Together with the Division of Emergency Medicine, research activity is applied to human physiology research during diving and hyperbaric conditions as well as to emergencies under special environmental conditions e.g. cold and drowning.

**Selected Publications:**

Department of Dermatology and Allergology

Head of Department: Prof. Dr. Karin Scharffetter-Kochanek

Keywords: Aging | allergy | autoimmunity | dermatology | melanoma | stem cells | wound healing

Our department’s mission is sustained leadership in patient care, in clinical and basic research, and in educating leaders of dermatology and allergology in an environment that fosters creativity, excellence and synergy. Dermatology in general, and dermatology at Ulm University in particular, has undergone an impressive development from descriptive morphology to understanding pathomechanisms with systemic and targeted therapies. An intensive program aimed at education, research and patient service has been established at the department with the focus on allergy, autoimmune and inflammatory diseases, wound disorders and regenerative medicine, malignancies, aging, and infectious disorders of the skin. The department offers fully accredited postgraduate training with Board Certification. Research goals are to explore mechanisms of skin biology and to gain insights into aging, inflammatory diseases, skin tumors and wound healing. Our research is organized in part within the Clinical Research Group KFO142 (“Molecular and cellular aging – from mechanisms to clinical perspectives”), the Research Training Group GRK1789 (CEMMA – “Cellular and Molecular Mechanisms in Aging”), and the Research Nucleus SyStaR (“Molecular Systems Biology of impaired stem cell function and regeneration during aging”). Funded clinical studies comprise targeted tumor therapies and allergies in the elderly. Major research topics and/or clinical foci include: skin aging and related diseases; immunosenescence and adaptive immunity; progeroid syndromes; stem cells and their niches in aging and regeneration including wound repair and skin carcinogenesis. More recently, we have established research lines for aging-related diseases including the molecular dissection of mechanisms underlying type I allergies in the elderly (ATOPICA), Histologic techniques help to understand the pathogenesis of malignant melanoma and other skin diseases.
chronic non-healing wounds in the elderly, and the senescence-associated secretory phenotype of senescent fibroblasts driving melanoma progression. Our thematic foci in research are reflected in our clinical specialization. Accordingly, our clinic has been certified and accredited as a Center of Excellence for Allergic Diseases (Global Allergy and Asthma European Network) and Skin Tumors (Hauttumorzentrum). In addition, we have been accredited as a center specializing in diagnostics and the care of patients suffering from wound healing disorders (Wundsiegel). Our specific clinical focus is on inflammatory skin diseases and complex autoimmune disorders (e.g. psoriasis, atopic dermatitis and contact dermatitis, lupus erythematoses, scleroderma and dermatomyositis), skin tumors as well as on wound healing disturbances with the goal of enhancing the interdisciplinary quality of patient care and therapy. Recently we have established a Center for Extracorporal Photopheresis (ECP). The ECP technique employing three running machines has been developed to successfully treat graft-versus-host disease after stem cell transplantation. The continuous support of our entire community consisting of the faculty, patients, friends and alumni will be instrumental in providing the resources needed to support trainees, the junior faculty, advances in patient care and original research in the future.

Selected Publications:

Department of Gynecology and Obstetrics
Head of Department: Prof. Dr. Wolfgang Janni
Keywords: Biomarkers | Cancer Susceptibility | Angiogenesis | BRENDA | DNA repair

The scientific projects were supported by the BMBF, DFG, German Cancer Aid, Sander Foundation and Alexander von Humboldt Foundation.

Biomarkers for Cancer Susceptibility

Algorithm-based pedigree and candidate gene analyses are the pillars for the identification of breast and ovarian cancer risk to license intensive care programs. Considering the demographic development and the fact that predisposing mutations explain less than a third of the risk, new research avenues were taken. Because most risk genes are linked with DNA repair deficiencies, a corresponding test system was developed for primary cells from patient samples (EP1399576). Analysis of cells with defined risk genes revealed a functional signature as a potential phenotypic biomarker. The first case-control study for prospective evaluation of this signature was based on the BMBF-funded BRENDA platform and revealed association with familial risk. Importantly, this biomarker captures various defects and thus exceeds the limits of genotyping.

While normal cells preferentially use the accurate HR (homologous recombination) DNA repair pathway, cells from individuals with hereditary breast cancer risk, such as due to a defect in the BRCA1/2 pathway, shift to inaccurate pathways such as SSA (single-strand annealing) and NHEJ (non-homologous recombination) resulting in chromosomal aberrations.
Angiogenesis and the Ovarian Hyperstimulation Syndrome

Hormonal stimulation by hCG was found to increase VEGF levels followed by downregulation of adhesion proteins and thus increased permeability. Comparable mechanisms were discovered in ovarian cancer for the first time unveiling the pathomechanism of ascites production.

Student Education

In addition to lectures, students are trained in a one-week clinical rotation to gain insight into the processes of our outpatient clinic, ultrasound department, surgery rooms and labor ward. A skills laboratory with breast and pelvic examination models as well as a laparoscopic surgery training model and a sophisticated delivery trainer (Noelle) are employed. In addition, we offer voluntary courses for advanced students, ranging from interdisciplinary breast cancer to assisted reproductive techniques and intensified obstetric training. Clinical rotations (2-6 weeks) are well established for national and international students and a two-day revision course supports our students before the final exam.
The Department of Neurology is comprised of an inpatient clinic (Rehabilitations- und Universitätskliniken Ulm, RKU) and an outpatient clinic. The inpatient clinics integrate compassionate care with state-of-the-art research in general neurology and specialized areas. Our expert subspeciality care is aided by advanced diagnostic procedures that include 24/7 availability of MRI, the department's own CSF- and histological laboratory for muscle biopsies. We offer acute and rehabilitation facilities with an intensive care unit and a 27-patient stroke unit/intermediate care unit, with 24/7 availability for the full spectrum of modern stroke therapies. The specialized outpatient clinics are headed by renowned experts in the field and cover motor neuron/neuromuscular disorders, movement disorders such as Parkinson's and Huntington's disease, inflammatory CNS diseases, dementias, epilepsy, pain, and neurooncology. Besides serving as a specialized teaching and training center, the Center for Clinical Studies includes a large biobank. The center allows access to cutting-edge therapies and is fully financed by external sources as well as being an active partner in national and international networks.

Experimental neurology covers a broad spectrum of basic and clinical neurological research. The Neurophysiology Section focuses on neurophysiological assessment of oculomotor/vestibular functions together with functional neuroimaging and clinical Neuroophthalmology. The group for clinical neuroanatomy works on the neuropathological assessment of neurodegenerative diseases and, in 2013, added a novel neuropathological staging system for other neurodegenerative diseases, i.e. ALS and frontotemporal dementias, to their former groundbreaking staging systems in Parkinson's and Alzheimer's disease. Further subunits are the groups for synucleinopathies, for cell biology and in vivo models of ALS/MND, for molecular mechanisms of ALS, for striatal degenerations, and neuroinflammation. Topics of research are Alzheimer's disease, frontal dementias and CSF-based proteomics/biomarker, CSF diagnostics, and experimental...
neuropsychology. All these research groups participate in the Academic Neuroscience Center Ulm (NCU) and cooperate closely with other NCU members and core facilities, in addition to a multitude of external network partners, e.g. CNS Research Boehringer-Ingelheim, and international academic neuroscience centers.

We provide a rigorous teaching concept for medical students that includes various clinical courses (including Neuro-TRACK) and a structured teaching program for the Practical Year (Teaching Bonus of the University in 2013).

1. In sporadic ALS, TDP-43 pathology develops in Betz pyramidal cells of layer VB in the primary motor cortex (upper left photo): Detail (upper middle photo) shows a single Betz cell at high resolution with pTDP-43 aggregates in the somatodendritic compartment and in unmyelinated initial portions of the axon. The pathology also develops in spinal cord ventral horn (upper right photo) alpha-motoneurons of layer 9 and in dendrites and axons heading toward the ventral root. Lower photo: Bilateral pathology in axons and cell bodies of motor neurons of the hypoglossus nucleus (N. XII) in the lower brainstem.

2. MRI with 24/7 availability as our standard diagnostic imaging tool in acute ischemic stroke; as an example MRI-stroke imaging before and after intravenous thrombolysis in combination with mechanical recanalization.

Upper panel: before therapy, diffusion-weighted imaging (DWI) of the ischemic stroke (a) with a diffusion-perfusion-mismatch in perfusion-weighted imaging (b) due to a thrombus in the right middle cerebral artery (MCA) in T2* weighted imaging (c) and occlusion of the right MCA in TOF-angiography (d).

Lower panel: after therapy, reduction of the ischemic tissue in DWI (e) after successful recanalization of the MCA (f).
The Department of Ophthalmology covers the entire spectrum of surgical and medical ophthalmology. With a team of 25 physicians, we treated 3,272 inpatients and 23,063 outpatients in 2012, during which eight fellows from other countries and about 20 students worked in our department.

Ophthalmic surgery in the department mainly focuses on cataract, vitreoretinal surgery, glaucoma, lid surgery, refractive surgery as well as penetrating and lamellar keratoplasty (DMEK). In the area of non-surgical ophthalmology, the section for medical retina focuses on retinal vascular diseases, diabetic retinopathy and age-related macular degeneration, and provides diagnostic procedures and treatment. Retinal laser surgery, photodynamic therapy as well as intravitreal injections (IVOM) are also performed. In the area of medical, clinical and basic retina research, the focus is on age-related macular degeneration and diabetic retinopathy (Heads: Prof. Gabriele E. Lang; Dr. Heidrun Deißler).

A daily morning conference, noontime case presentations in the clinic and daily rounds on the inpatient floors in addition to a weekly advanced training conference all contribute to a consistent and high level of education. An ocular pathology conference and case readout take place once a week.

As a university hospital we consider it our duty to improve and expand our achievements by employing the latest research data and technology in diagnostics and treatment. Since the establishment of the Department of Ophthalmology, the entire team of doctors has continuously sought to provide optimal treatment for our patients.
Our efforts are regularly monitored by external questionnaires (PICKER-study 2004 and 2007) to evaluate patient satisfaction. An external questionnaire on health insurance schemes published in 2009 confirmed the achievement of our goals.

In the area of general satisfaction concerning results of treatment, nursing care as well as information and communication, our department scored 4-7 % above average among all participating departments.

The successful certification of patient care, teaching and research according to ISO 9001 was confirmed in 2013 in an external audit.

The residency program has a certification in line with the European Board of Ophthalmology regulations.

Our most important aim is the optimum care of our patients according to the highest standards and within a pleasant atmosphere. The results have so far been extremely satisfying and it is our intention to continue in this vein.
Department of Orthopedics
Head of Department: Prof. Dr. Heiko Reichel
Keywords: Adult Reconstruction and Joint Replacement | Molecular Orthopedics | Orthopedic Oncology | Pediatric Surgery | Spine Surgery | Sports Medicine

The Department of Orthopedic Surgery at the RKU is one of the largest orthopedic university institutions in Germany and covers all aspects of musculoskeletal diseases, including in- and outpatient surgical and non-operative care, as well as orthotics and prosthetics. More than 3,500 surgical procedures are performed annually and about 13,000 patients are seen in our Outpatient Department. The wards, with a total of over 150 beds, include a special unit for spinal cord injury and a day clinic for a multidisciplinary musculoskeletal pain program. Before surgery, conservative treatment options are always taken into account. If the conservative approach fails to restore an acceptable level of function and to decrease pain, up-to-date procedures are performed. We guide patients through the various stages of their disease by diagnosis, treatment and rehabilitation.

Different subspecialties focus on total joint replacements of hip, knee and shoulder joints as well as elbow and ankle joints, joint reconstruction, spine surgery, pediatric orthopedics, sports medicine, orthopedic oncology and orthopedic rheumatology. On referral, septic and revision surgery is another option. In some cases, fractures of the extremities and the spine are also treated. Modern trends lead to smaller incisions (minimal-invasive surgery), computer-aided implantation of joint replacements (navigation) and to bone-preserving implants. The best treatment of the individual is...
guaranteed by the selection of the most appropriate procedure and the optimized implant. Research activities focus on biomechanical aspects (development and testing of joint and spinal implants) and molecular biological and biochemical techniques in bone and soft-tissues. Several dissertations and “Habilitations” have been conducted at our Institute. The teaching of our students and residents together with an international instructional course in spine surgery are additional academic activities.

Important cooperation is maintained with the Department of Traumatology (Head: Prof. Dr. F. Gebhard), the CCCU (Comprehensive Cancer Center Ulm) and the Institute of Orthopedic Research and Biomechanics (Head: Prof. Dr. Anita Ignatius).

The Orthopedic Department incorporates the division for Biochemistry of Joint and Connective Tissue Diseases (Head: Prof. Dr. Rolf Brenner). This division concentrates on clinically-oriented basic research within the musculoskeletal system and coordinates the experimental research of the department. The interdisciplinary working group (covering molecular medicine, biology, and biochemistry) consists of 12 employees (including four PhD students). Our research focuses on the pathophysiology and therapy of cartilage diseases (e.g. cartilage trauma and osteoarthritis), the role of mesenchymal stem cells in skeletal disease and tissue regeneration as well as cell-biomaterial interactions (e.g. surface functionalization of implants and nanotechnology). Research projects are currently funded by the DFG, the BMBF and the Center for Musculoskeletal Research Ulm. In 2013, the research prize of the German Society of Arthroplasty (AE-Preis) was awarded for one of our studies on biofunctionalization of implant surfaces.

Navigation system for the implantation of orthopedic implants (e.g. total knee replacement)

Selected Publications:
The Department of Otorhinolaryngology (ORL), certified according to DIN EN ISO, offers state-of-the-art diagnostics and therapy in the field of oncology and reconstructive surgery, rhinology, ear surgery, including cochlear and middle ear implantation, as well as computer/robot-assisted surgery. It has been certified as a “Head and Neck Cancer Center” by the German Cancer Society and is part of the Comprehensive Cancer Center Ulm (CCCU). Our special expertise lies in the interdisciplinary treatment of head and neck cancer, including high-end surgical resection with plastic reconstructions as well as (chemo/immuno) radiation in a primary, adjuvant and palliative setting. The scientific focus and expertise of our department centers on tumor immunology and the integration of immunotherapy strategies.
Selected Publications:


into standard treatment. Thus, a variety of clinical trials are offered which have been approved by the local ethical board. Our extensive expertise in rhinology is not only based on septorhinoplasty, surgical nasal reconstruction and anterior skull base surgery but also includes research activities such as intranasal air conditioning and the numerical simulation of intranasal air flow in computer models.

Furthermore, our recognized research group specializing in regenerative medicine is focused on cartilage tissue engineering for reconstructive head and neck surgery, and regeneration of salivary gland tissue using stem cells for patients suffering from severe dryness of mouth (xerostomia). The division of phoniatry and audiology has established an important partnership with the Hearing Implant Center which also performs high standard phonosurgery. The teaching of medical students and international guests is performed in a multidisciplinary skills lab and recognized operation courses.

The ORL Department at Ulm University covers an area of over two million inhabitants and is comprehensively equipped with four operating rooms, four intensive care beds and a 24 hour emergency service as well as an optimal research lab with a translational scientific focus to ensure high-end patient care.
At the Department of Pediatrics and Adolescent Medicine of Ulm University, we offer comprehensive and high-quality patient care for children and adolescents. The hospital has a capacity of 117 beds and employs over 400 personnel. It is our goal to obtain the best treatments possible based on the latest diagnostic and therapeutic concepts.

All relevant areas of expertise are represented at our hospital which has gained a high reputation, both nationally and internationally, in the areas of bone marrow and stem cell transplantation, solid tumors, leukemia and blood diseases, immunology, preterm and neonatal medicine and hormone-related diseases, such as diabetes. We are a supraregional center specialized in the fields of cardiovascular disease, gastrointestinal disease, kidney disease and mucoviscidosis.
We also make provision for all the support and guidance needed during and after a stay at our hospital. In our new buildings most rooms are constructed as mother-child units in order to allow parents to stay with their child during treatment. Additional services include apartments for parents of inpatients, playrooms, visits of clown doctors, bedside learning, art and music therapy, interpreters, dietary advice, a consultation service as well as sociomedical and psychosocial aftercare.

Our research has a strong focus on hematology and oncology. It is dedicated to understanding the role of cell death (apoptosis) and cell death signaling in diseases, such as cancer, with the aim of developing new therapies from this knowledge. A particular focus is centered on strategies to overcome treatment resistance in leukemia, neuroblastoma and brain tumors.

In the area of stem cell transplantation and immunology, our work groups have significantly contributed to the development of blood stem cell and bone marrow transplantations and have characterized the genetic heirs of several forms of severe combined immune defects (SCID).

Our research team specializing in pediatric endocrinology and diabetes aims to elucidate the molecular causes of endocrine and metabolic diseases by focusing on special forms of diabetes mellitus and rare adipose tissue disorders such as lipodystrophy. Furthermore, we study the causes and effects of obesity in childhood and adolescence and develop novel therapy strategies.

Other important research fields of our department are non-malignant hematological diseases, primary care and developmental prognosis of preterm infants, as well as attention-deficit/hyperactivity disorder (ADHD). Our largest research projects are described separately in the Research Centers section of this report.

Immunofluorescence analysis of a glioblastoma cell.
Department of Urology

Acting Director of the Department: PD Dr. Florian Jentzmik

Keywords: Minimal invasive surgery | neobladder | prostate cancer | systemic therapy | urooncology

The Department of Urology is one of the largest urological centers in Germany that offers the whole spectrum of modern diagnostics and therapy in both adult and pediatric urology. Fifteen physicians (seven specialists and eight residents), ten surgical nurses, 56 carers and general nurses as well as eight administrative secretaries arrange an optimal daily academic and clinical routine.

Our commitment is to quality and value by providing facilities for advanced surgical procedures combined with friendly and professional care. Our department has 55 beds with all rooms offering the privacy and comfort of en-suite facilities, satellite TV and telephone. The hospital has four theaters (ORs), one minor procedures theater, a six-bed intensive care unit and a seven-bed high dependency unit. These facilities, combined with the latest technology and on-site support services, enable us to perform a wide range of procedures from routine investigations to complex surgery.

This specialist expertise is supported by a caring and professional medical staff that, together with dedicated nursing teams and resident medical officers on duty 24 hours a day, provides care within a friendly and comfortable environment.

The Department of Urology is particularly specialized in the treatment of urological malignancies. It is this clinic that conceived and developed the ileum neobladder, which has today become the most accepted form of continent urinary diversion worldwide for patients with invasive bladder cancer. Moreover, the Department of Urology and its members possess the skills and expertise for the treatment of localized and metastatic prostate, renal and testicular cancer. Several of our surgeons are specifically specialized in conventional and robotic-assisted (da Vinci SI HD System®) laparoscopic radical prostatectomy. All therapeutic procedures are based on interdisciplinary tumor board decisions.
As one of the first established centers we offer a novel endoscopic technique, the thulium laser transurethral enucleation (ThuLEP) for the treatment of benign prostatic hyperplasia that can even be used in patients under anticoagulant/antiplatelet therapy. As a matter of course, we also offer up-to-date reconstructive, endoscopic and female urology surgery as well as special consultation hours for andrology and pediatric urology. Moreover, we possess an ultra-modern extracorporeal shock-wave lithotripter to locate urinary stones by applying ultrasound as well as X-ray technology.

The Department of Urology at Ulm is also active in clinical (phase I-IV) trials as well as fundamental research. We have a fully equipped laboratory for experimental/molecular urology as well as molecular genetics of prostate cancer that is headed by two experienced biologists. Our main focus is on the discovery of potentially clinically-relevant alterations in tumor biology and tumor cell signaling. This research area with its clear translational background is currently being established in close collaboration with the clinic.
Department of Diagnostic and Interventional Radiology

Head of Department: Prof. Dr. Meinrad Beer
Keywords: Functional imaging | molecular and metabolic imaging | tissue typing | minimal-invasive interventional procedures

The department provides all radiological services for Ulm University Medical Center as a tertiary hospital center. Additionally, it supplies two further hospital centers, one focused on Neurosciences and the other serving as a secondary hospital center. The department is equipped with cutting-edge technology.

Three divisions have been established. The Division of Neuroradiology (headed by Prof. B. Schmitz) was founded some years ago and has rapidly grown to encompass the fields of both diagnostic and interventional neuroradiology. The interventional treatment of intracerebral aneurysms has been expanded to include flow diversion in addition to surgical clipping and coiling procedures. The interventional treatment of acute stroke patients has considerably been improved through the use of stent retrievers.

The impact of functional neuroimaging has significantly increased in recent years. The Division of Neuroradiology focuses its clinical and scientific interests especially on the areas of speech production and recognition by using functional MRI techniques (fMRI). fMRI studies allow a precise planning of primary surgery in brain tumor patients (figure 1). Additionally, fMRI studies in obese patients receiving minimal invasive therapy with a balloon catheter were started in order to analyse the interdependency between obesity and brain activation.

Two divisions were founded in 2013. The Division of Interventional Radiology performs a wide range of hepatic, vascular and biopsy interventions. The second division, the Division of Experimental Radiology founded in 2013, serves as a core facility for imaging in cooperative projects with other departments and develops its own imaging techniques.
One project deals with new T2* techniques for determination of liver iron content. Iron overload is an increasing clinical problem. New MR techniques based on multiple flip angles allow reliable measurements even at high levels of iron overload. A recent multicenter study, headed by our department, develops and applies these new state-of-the-art MRI techniques for non-invasive liver iron monitoring.

Research activities of the department also cover the field of cardiovascular radiology. CTCA (CT-coronary angiography) is applied for the planning of coronary interventions as well as minimal-invasive heart valve replacement (TAVI). The implementation of cutting-edge technologies for lowest dose-protocols allowed a significant improvement of CTCA techniques (figure 2a+b).

Further research projects are performed in collaboration with the Core Facility Imaging (headed by Prof. V. Rasche) and the Department of Nuclear Medicine (headed by Prof. A. Beer). Future research directions encompass neuroradiologic morphometric analyses (voxel-based volumetry), oncologic, metabolic and molecular imaging techniques (31P-MR-Spectroscopy and Diffusion-weighted Imaging -DWI) and, finally, noninvasive MRI-based tissue typing techniques (T1/T2/T2*-mapping and 1H-double triggered 1H-MRS).

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Selected Publications:

Figure 2a shows the superb 3D-visualisation of the left main coronary branch with its two main side branches (LAD and CX). State-of-the-art reconstruction algorithms allow the stretched presentation of the complete course of single arteries as outlined in figure 2b. Improved CT-techniques enable the sight through coronary stents.
Department of Nuclear Medicine

Head of Department: Prof. Dr. Ambros J. Beer (since February 2014); Prof. Dr. Sven Norbert Reske (until February 2014)

Keywords: PET/CT | prostate cancer | pharmacokinetic modeling | thyroid cancer | molecular imaging

The Department of Nuclear Medicine provides the whole spectrum of diagnostic and therapeutic methods needed for a “tertiary referral center” setting.

The research focus of the Nuclear Medicine Clinic is the development of PET- and PET/CT-based molecular imaging techniques and targeted internal radiotherapy. The available infrastructure includes a molecular and cell biology working group, a radiochemistry section, a dosimetry and a tracer kinetic modeling group, a fully equipped PET center, including a cyclotron, radiochemistry and pharmaceutical laboratories, and one PET/CT scanner. A “small animal PET scanner” is also available at the institute.

The research focus is in the fields of tumor biology, PET and PET/CT imaging, radiotracer development, with a special emphasis on prostate cancer imaging, and the development of strategies for targeted radiotherapy with monoclonal antibodies. State-of-the-art medical physics expertise is provided in dosimetry, PET and PET/CT imaging, tracer kinetic analysis and pharmacokinetic modeling.

Current projects focus on the development of radiolabeled peptides for imaging and staging prostate cancer. Highly specific Ga-68 labeled peptides binding within the picomolar range to prostate-specific membrane antigen (PSMA) are of special interest and are already in clinical use for imaging relapsing prostate cancer. A new focus is on multimodal multiparametric imaging and analysis of tumor biology by combining morphological, functional and molecular imaging from PET and MRI.
The management of thyroid diseases, with a particular focus on cancer therapy, represents a main field of interest in patient care, as well as novel therapies with alpha-emitters such as Xofigo, for bone metastases, and targeted therapies such as PRRT (radiopeptide therapy targeted against the somatostatin receptor) in neuroendocrine malignancies.

Studies on individualized dosimetry to calculate tailored therapy activities for various radionuclides (dose escalation) have in the past resulted in optimized care for the conditioning of patients by using monoclonal antibodies in the preparation of stem cell transplantation in high-risk leukemia.

Selected Publications:

Cellular Response to Cancer Treatment
With regards to the importance of combined treatment modalities involving radiotherapy, cell-biological studies on the influence of androgen supply on chemo- and radiosensitivity of prostate cancer cells are conducted. Cell survival, gene expression and functionality, DNA damage and repair are major objects of research.

Individualized Risk Assessment
The multi-institutional study PASSOS aims to assess the risk of second cancer and of heart disease after radiotherapy for breast cancer. Retrospective dosimetry is carried out in the treatment plans of women whose heart was co-exposed during breast irradiation. In close collaboration with the Department of Gynecology at Ulm and with the University Hospital in Mainz, we address the risk of heart disease depending on the individual radiation dose and other treatment-related parameters as well as general cardiovascular risk factors (e.g. age, weight). The study is funded by the Federal Ministry of Education and Research.

Improving Prostate Cancer Treatment
Prostate cancer is the most common cancer in adult men. When assessing different therapy options, decision-making is largely influenced by aspects affecting quality of life. To reinforce decisions based on objective criteria, detailed analyses of stage-of-disease dependent treatment outcome are mandatory. By means of our data and expertise we contribute to the periodical updates in treatment guidelines for prostate cancer.
Up-to-date Treatment at Two Sites

A most recent radiation technique known as RapidArc® is currently available on two linear accelerators in our department. In this treatment mode, the head of the therapy device moves around the longitudinal patient axis while continuously adjusting its aperture to the tumor shape which changes with the shifting angle. This strategy aims to minimize the exposure of normal tissue to radiation. Since its opening in 2011, our sister clinic in Ehingen has treated 800 patients. Similarly, as at Ulm, the panel of radiation modalities includes IMRT, RapidArc® and IORT.

Involvement in Clinical Studies:
PNET/Medulloblastoma and ependymoma in young patients: HIT-2000.
Prostate cancer: PRETRE, ART-2.
Squamous cell carcinoma of the head and neck: DÖSAK pN1.
Hodgkin’s lymphoma: PVAG-14; HD 16,17,18.
Spinal cord metastasis: SCORE-2.

Radiation damage visualized in the nuclei of prostate cancer cells (left: γ-H2AX). Unless the damage is repaired, cell death will ultimately occur (right: apoptosis).

Selected Publications:
Department of Psychiatry and Psychotherapy I
Head of Department: Prof. Dr. Wolfgang P. Kaschka
Keywords: Affective disorders | mechanisms of antidepressant action | neurobiology | electrophysiology | suicide research

The South Württemberg Center for Psychiatry in Ravensburg provides comprehensive clinical psychiatric care services for a population of approximately 450,000 people. There are seven specialist departments (Depression, Psychosomatic and Psychotherapy, Geriatric, General-Social, Addiction, Child and Youth, and Forensic). In an average year, approximately 4,000 inpatients pass through the center. The academic staff includes 39 physicians and 21 psychologists. The percentage of female employees is 50%.

Psychiatric Services
The hospital provides specialized wards for patients with affective disorders and personality disorders. There is an outpatient clinic with special services for patients with affective disorders (burnout syndrome, lithium clinic), dementias (memory clinic) and addiction. A crisis intervention unit also provides home treatment. An integrated system of quality management is employed (KTQ).

Research Topics

Neurophysiological Research
Electrophysiologic techniques are employed to characterize differences in habituation patterns between those patients identified as at particular risk of suicide and those that are not. Particular variations found in components (P300) of patient encephalograms and in electrodermal activity (EDA) taken during auditory discrimination tests are subjected to further analysis and intergroup comparison (suicide attempters vs controls). The combination of clinical observation with electrophysiologic profiling is used to develop biological risk markers for suicidal behavior.
Molecular Biological Research

We use the nematode worm *Caenorhabditis elegans* as a model system. The combination of a simple body plan and sequenced genome, together with established techniques for genetics and cell/molecular biology, makes *C. elegans* ideal for such work. At the same time, many biochemical and signaling pathways are conserved between humans and *C. elegans*, making the application of research findings within a human context much easier.

Currently, we have three ongoing, interrelated projects in the lab:

1. Identification of temporal/cell-specific changes in Insulin/TGF-β signaling that trigger fat accumulation during diapause (metabolic depression of activity in response to stress).
   
   (Manuela Hörnle, Steve Hodgkinson)

2. Changes in nuclear hormone receptor binding activity in response to treatment with atypical antipsychotics.
   
   (Steve Hodgkinson)

3. Changes in the serotonin-guanylate cyclase signaling pathway in response to treatment with antidepressant drugs.
   
   (Isabelle Hellwig, Steve Hodgkinson)
Department of Psychiatry and Psychotherapy II

Head of Department: Prof. Dr. Thomas Becker

Keywords: Mental health services research | process outcome | health economics | meta-analyses | gender-specific aspects | dementia | schizophrenic psychoses | stigma

The Clinic of Psychiatry and Psychotherapy II at Bezirkskrankenhaus Günzburg offers mental health care consisting of inpatient services, two day care units, an outpatient clinic and home treatment for 671,000 inhabitants of a catchment area in rural Bavaria.

The department has two research groups: **Psychoimmunology** (Prof. Dr. Karl Bechter); **Psychopathology and Psychopharmacology** (Prof. Dr. Markus Jäger); and four sections: **Health Economics and Health Services Research** (Prof. Dr. Reinhold Kilian); **Process-Outcome Research** (PD Dr. Bernd Puschner); **Geriatric Psychiatry** (Prof. Dr. Matthias Riepe); and, since 2013, **Public Mental Health** (Prof. Dr. Nicolas Rüsch).

Some of the department’s numerous research projects are highlighted in the following list:

- **Clinical decision making and outcome in routine care for people with severe mental illness (CEDAR)**. To investigate the effect of clinical decision-making on crucial dimensions of clinical outcome (symptom level, quality of life, needs) by means of a multinational prospective study (funded by the European Commission, grant no. 223290).

- **Cochrane review of implementation of treatment guidelines for specialist mental health care**. The aim of this systematic review is to summarize the evidence pertaining to the effects of guideline implementation in specialist mental health care in view of specific implementation strategies (funded by BMBF, ref. code/FKZ 01KG1109).
• **Effectiveness and cost-efficiency of contracts in integrative care from patients suffering serious mental illnesses in real surroundings with particular attention to improvement of empowerment and quality of life (IVPOWER).** The focus of this project is the transregional analysis of effectiveness and cost-effectiveness of contracts for integrated care programs according to NWpG (NetzWerk psychische Gesundheit) compared to the usual treatment in real surroundings (funded by BMG, ref. code/FKZ II A 5 – 2513 FSB 012).

• **Psychiatric discourse on desire for children and parenthood among people with mental illnesses.** The study investigates the psychiatric discourse as well as subjective attitudes of mental health professionals in regard to desire for children and parenthood (study in collaboration with the Institute of the History, Philosophy and Ethics of Medicine, Ulm University; funded by DFG, ref. code/GZ KR 3879/1-1).

• **Identification of psychopathological course types in schizophrenic psychoses.** To identify homogenous subgroups of schizophrenic disorders with respect to the psychopathological course and outcome and to correlate these subtypes with neurobiological markers (funded by DFG, ref. code/GZ JA 1742/2-1).

• **Efficacy and safety of add-on therapy with calcium-antagonist nilvadipine in patients with mild to moderate Alzheimer’s disease (NILVAD).** The study tests the efficacy and safety of nilvadipine in 500 subjects with mild to moderate AD over a treatment period of 18 months (funded by the European Commission, grant no. 297093).

Selected Publications:


The department’s scientific focus is on systems neuroscience aspects of mental disorders. Cognitive and affective neuroscience methods are used to understand high-level cognitive functions in normal subjects, and the development and maintenance of psychiatric disorders. Most of the research takes place in three cooperating divisions. Research on the transfer of neuroscience findings into educational practice is conducted at a dedicated research center that is part of our department and known as the Transfer Center for Neuroscience and Learning.

The division for Functional Imaging and Neuropsychology (Prof. Dr. phil. Georg Grön) includes a high-field magnetic resonance scanner dedicated to research. Brain imaging under different functional challenges is used to investigate and explore human brain functions under circumscribed experimental conditions. The focus is on mental functions (e.g. memory, reward processing, motivational and emotional processes) and dysfunctions that correlate with psychiatric disorders.
Employing appropriate study designs, commonalities and differences between normal and impaired brain functioning are investigated. In 2014 the actual scanner will be replaced by a new state-of-the-art high-field magnetic resonance scanner which is planned to serve as a campus-wide core-facility for all research groups working in the field of imaging neuroscience in humans.

In the division for Cognitive Electrophysiology (Prof. Dr. phil. Markus Kiefer), the scientific focus is on language, higher conceptual representation and attention. A state-of-the art 64-channel electroencephalographic recording system permits the study of brain electrical activity at high temporal resolution.

In the division for Neurostimulation (Prof. Dr. med. Thomas Kammer), the physiological background of non-invasive brain stimulation techniques, such as transcranial magnetic stimulation or transcranial DC-stimulation is explored. In clinical trials, the therapeutic potency of stimulation techniques in several psychiatric disorders is investigated.

In the Transfer Center for Neuroscience and Learning (ZNL), a multidisciplinary team of teachers, psychologists and educational scientists integrates recent neuroscience findings into practical applications in the field of education in children and adults. The general aim is to use the well-established medical model of translational research in the field of education.
Department of Child and Adolescent Psychiatry and Psychotherapy

Head of Department: Prof. Dr. Jörg M. Fegert
Keywords: Childhood trauma | specialized outpatient clinics | psychotherapy research | clinical studies | child abuse and neglect

The department provides inpatient and outpatient care as well as day treatment for children and adolescents with psychiatric disorders and psychosocial problems: two wards for adolescents with a total of 19 beds; one ward for children with 12 beds; and a day care unit for 18 patients. The department also offers several specialized outpatient clinics: a unit for children in out of home placement, be it in foster care or institutions; a trauma unit; a tic and Tourette's unit; and, since recently, a Phelan-McDermid outpatient clinic. Additionally, a section for psychotherapy research combined with a training institute in child and adolescent behavior therapy (AZVT) and an outpatient psychotherapy clinic were established in 2009.

With an interdisciplinary team of expert researchers integrated into central research management and a competent consulting methodology, we are active in four research areas: biological and clinical research; prevention, social psychiatry and health care research; ethics, law, forensics; and family, time politics and e-Learning. All four areas have been expanded in recent years and all were very successful in raising external funding.
We mainly focus on questions of childhood trauma, especially child (sexual) abuse, and specialize in web-based strategies of intervention and dissemination (e.g. missbrauch.elearning.kinderschutz.de, fruehehilfen-bw.de). With its aim to raise awareness of (sexual) child abuse and neglect within the medical field, the Competence Center Child Abuse and Neglect (www.comcan.de) was founded 2013 in Ulm in cooperation with the university hospitals in Heidelberg and Freiberg, and is sponsored by the Baden-Württemberg Ministry of Science, Research and the Arts (MWK). Another area of expertise involves research into non-suicidal self-injury and suicidality in adolescence by incorporating research projects on prevention, intervention and neurobiology.

Selected Publications:
Department of Psychosomatic Medicine and Psychotherapy

Head of Department: Prof. Dr. Harald Gündel
Keywords: Emotion regulation | molecular psychosomatics | workplace mental health | trauma | psychotherapy | pain | psycho-oncology

The department offers a combined psychosomatic-psychotherapeutic inpatient and day hospital treatment. Moreover, it provides an outpatient service and psychosomatic consultation as well as liaison, which includes a psycho-oncology service. All kinds of mental disorders that can be reliably managed by means of psychotherapeutic procedures are the focus of the clinic, such as somatoform, pain, personality, eating and somatopsychic disorders, i.e., depressive or anxiety disorders in chronically ill or oncological patients. Within five different settings providing evidence-based treatments, such as group psychotherapy and relaxation training, our acute patients are provided with the best available multimodal psychotherapeutic care of an integrative university clinic. Services for “psychosomatic consultation at the workplace” have also been implemented. Medical and psychological education for students, as well as advanced education for all professions involved in psychosomatic medicine, have been structurally organized. Training institutes of psychoanalytic and psychodynamic (UPPI) and behavioral psychotherapy (AWIP) also work in association with our clinic.

Areas of research

I) Experimental research

Emotion regulation focuses on: (a) continuous emotion recognition based on psychobiological signals for utilization in cognitive-technical systems; (b) the development of computer-based emotion recognition methods using facial expressions; and (c) the advancement of an automated pain recognition system on the basis of facial expressions and psychobiological parameters.

The main research aims of the Laboratory of Molecular Psychosomatics are to extend current knowledge of the mechanisms underlying: 1a) psychosocial stressor/trauma-induced development of somatic and affective pathologies; and 1b) individual differences in stress/trauma resilience; and 2) to use this mechanistic knowledge for the development of novel strategies to prevent psychosocial stress/trauma-induced pathologies. For this purpose, we employ several clinically relevant rodent models of chronic psychosocial stress/trauma and study in detail their effects on...
behavioral, physiological, neuroendocrine, and immunological parameters, thereby considering individual differences in the stress-coping strategy. Our main paradigm in this context is the chronic subordinate colony housing (CSC) paradigm, which induces chronic psychosocial stress/trauma by prolonged (19 days) social subordination of male experimental mice to a larger dominant male and results, along with what is known from humans, in increased anxiety-related behavior, social deficits, enhanced alcohol consumption, pronounced changes in hypothalamic-pituitary-adrenal (HPA) axis activity/reactivity, signs of hepatic oxidative stress and inflammation, development of spontaneous colitis, and an increased risk of inflammation-related colon carcinogenesis. Interestingly, CSC mice further show basal evening hypocorticism and a reduced glucocorticoid sensitivity of peripheral target cells. The latter is of particular interest as a decreased glucocorticoid signaling following chronic psychosocial stressor/trauma exposure is also discussed in humans as a possible mediator of stress/trauma-induced pathology. Interactions between psychosocial stress, trauma, attachment and bodily reactions are studied in humans (neuroendocrinological, fMRI).

II) Health services research/Workplace mental health

In the context of workplace mental health new preventive interventions have been developed and are in the process of being evaluated. Also establishing and evaluating psychosocial counseling within the workplace setting is an important research focus. Further studies are related to work and family-issues.

Health care studies are related to an improvement of psychotherapeutic services in a prototypical region. The specific effects of inpatient and day patient treatment for patients with depression as well as the effect of psychotherapy in treating anorexia nervosa are assessed in multicenter studies.

19 days of chronic subordinate colony housing induce development of spontaneous colitis. This is indicated by an increase in the histological damage and leukocyte infiltration, depicted in two representative colonic H&E sections [a: Lamina mucosa; b: Lamina muscularis mucosae; c: Lamina submucosa; d: Lamina muscularis (circular and longitudinal muscle)] from non-stressed control mice (Fig. C; normal colon histology) and from CSC mice (Fig. D; goblet cell loss and crypt loss in locally restricted areas; infiltration reaching the Lamina muscularis mucosae; thickening of submucosal areas) (adapted from Reber et al., 2007, Endocrinology)
The establishment of a new Department of Forensic Psychiatry and Psychotherapy at the District Hospital Günzburg was inaugurated in November 2013 and accompanied by the founding of a new chair of forensic psychiatry and psychotherapy at the Medical University of Ulm in May 2013. The department consists of 96 places within four maximum security wards for hospital treatment, 20 places within an open plan psychiatric care unit, and an outpatient unit for the follow-up care and treatment of 60 patients at present. Besides the nursing staff and co-therapists, about 15 physicians and psychologists administer assignments related to clinical treatment, research and teaching.

The main clinical assignment consists of both guarding and treating criminal offenders with psychiatric disorders, that is, mainly substance-related and addictive disorders, schizophrenia, personality disorders, neurodevelopmental disorders and paraphilia. The patients are not admitted to the hospital by physicians
but by an appropriate court in accordance with either s.63 or s.64 of the German Penal Code or in those cases where the following requirements are fulfilled. For example, persons are not responsible for criminal conduct if, at the time of such conduct and as a result of a mental disease or defect, they lacked substantial capacity either to appreciate the criminality (wrongfulness) of their conduct or were incapable of conforming their conduct to the requirements of the law. Furthermore, there must exist an increased risk of committing further criminal acts as a result of the psychiatric disorder in question. Treatment includes both psychopharmacologic and psychotherapeutic approaches depending on the disorder itself. Also, both individual and group therapies take place. Depending on the treatment progress, the patients may be transferred to the open ward and eventually undergo outpatient forms of treatment. For this to happen, thoroughly assessed predictions and expert opinions are required. Furthermore, assignments for expert opinions regarding both criminal and social law commissioned by the courts and other prosecution departments are accepted and conducted.

The above-mentioned new chair and professorship of forensic psychiatry and psychotherapy has recently been established at Ulm University with the aim of encouraging and inspiring students of medicine, psychology and law to undertake research into forensic issues. Both basic and applied research are a key focus of interest which includes behavioral and neurobiological investigations into the regulation of emotion processes, forms of attachment as well as addictive behavior in forensic patients. This also includes psychotraumatology issues within the context of forensic psychiatry, the impact of gender on the nature and cruelty of criminal acts resulting from mental disorders, as well as the research on levels of mental health, living conditions, and human rights under imprisonment. The treatment is both offense- and disorder-oriented and bears in mind the association between the crime committed and the linked mental disorder. We intend to evaluate the application of cognitive-behavioral strategies, such as dialectic-behavioral-based psychotherapeutic approaches within the context of forensics (DBT-F), and a reasoning and rehabilitation (R&R) program in order to help in the publishing of structured, transparent and applicable treatment manuals with the aim of improving not only the treatment but also the process of prediction assessment.

Selected Publications:

Department of Conservative Dentistry and Periodontology

Head of Department: Prof. Dr. Bernd Haller

Keywords: Endodontics | esthetic dentistry | minimal invasion | periodontology | restorative dentistry

The Department of Conservative Dentistry and Periodontology encompasses the disciplines of preventive and operative dentistry, endodontics, periodontology and pediatric dentistry. Our global mission is to preserve natural teeth. In restorative treatment, we are specialized in bonded tooth-colored restorations using resin composites and ceramics with the main emphasis on esthetics and minimal invasive procedures. Clinical care in endodontics covers vital pulp therapies, root canal (re-)treatments, internal bleaching and endodontic emergencies using endo microscopes and endo motors for preparation of curved root canal with NiTi rotary instruments. Patient care in periodontology covers treatment of chronic and aggressive periodontitis by scaling/root planning, surgical procedures and full-mouth disinfection. Advanced microbiological diagnostics is provided by our laboratory of oral microbiology.

Research activities are focused on in vitro and clinical testing of adhesive restorative biomaterials and on microbiological aspects of restorative, endodontic and periodontal treatment.

Team (full-time equivalency):
11 academic staff; 10.5 dental assistants; 4.5 dental/medical technicians; 2.25 administrative staff.

Dental treatment units:
15 (eight resident clinics, seven student clinics).

Selected Publications:
Department of Prosthetic Dentistry

Head of Department: Prof. Dr. Ralph Luthardt

Keywords: Applied material sciences | clinical trials | computer-aided dentistry and implantology | 3D-simulation

The Department of Prosthetic Dentistry administers comprehensive patient-oriented treatment after tooth loss. The primary goal is to preserve the remaining teeth and restore a healthy masticatory system. Our mission is to guarantee innovative and state-of-the-art care through the continuous ongoing education of the entire team. A total of 41 employees (66% female) are in charge of patient treatment, education and research: 13 dentists; 12 dental assistants; three trainees; five technicians; two technical assistants; six research assistants; and three external researchers. Nineteen internal and external PhD students are also being supervised. In 2012-14 the DFG Junior Academy (Nachwuchsakademie) “Dentistry” was successfully conducted.

Computer-aided manufacturing of dental restorations, 3D-planning based on cone beam CT for optimal implant positioning, minimal invasive implant surgery in addition to our synoptic patient centered treatment concept are the most innovative in prosthetic dentistry.

Our research topics are:

• clinical trials in oral soft-tissue management, dental implants and treatment strategies, removal of dental restorations by laser
• cross-linking clinical trials, in vitro and computer simulations (SimTOM, www.simtom.eu)
• dental material testing of advanced ceramic implants, restorations and veneering
• 3D analysis of digital workflows (from conventional and digital impressions to computer-aided manufactured restorations).
Department of Oral and Maxillofacial Surgery

Acting Director of the Department: Dr. Dr. Guido Guenter Schloemer

Keywords: Cleft palate

The Department of Maxillofacial Surgery within the Department of Odontology of Ulm University is a polyclinic equipped to provide maximum care. The work is undertaken by maxillofacial surgeons as well oral surgeons who are still in part-time education. One of these oral surgeons is female. The Institute of Radiology, furnished with all the X-ray devices relevant for this specialty, has been integrated into the department. In particular, a new digital volume tomography was supplied in 2009.

As part of the dental curriculum, the following events are held:
1. Course operation I and II.
2. Main lecture in oral maxillofacial surgery.
3. Lecture in dental medical science.
4. Lecture and course in radiology.

As part of a common research project within the departments of dentistry, the department takes part in oral maxillofacial surgery especially in the field of peri-implantitis.

With regards to maximum care, the whole spectrum of oral maxillofacial surgery as well as oral surgery is provided.

The main focus is on the treatment of patients with cleft lip and palate performed in collaboration with the departments of Otorhinolaryngology, Phoniatrics and Pediatric Audiology, Gynecology, Dermatology, and Pediatrics. Another main focus lies in the application of dental implants by employing all methods of augmentation.

Selected Publications:
Surface electromyography in the face using multi-electrode arrays. This method allows the determination of basic anatomic and neurophysiologic parameters (e.g., muscle fiber directions and motor endplate locations) on the level of the smallest functional unit of human musculature, i.e., the single motor unit. Such information is of fundamental interest and is useful for optimizing functional diagnosis and therapeutic strategies.

Selected Publications:

The department is an integral part of the Center of Dentistry and has approximately 25 employees that include orthodontists, postgraduate students, and scientists. The duties of the department are research, the education of dental students and specialists in orthodontics, and patient care.

Its main scientific topics lie in the fields of orthodontic biomechanics and neurophysiology of the orofacial and masticatory system. A scientific highlight is the development of smart brackets with an integrated sensor system for 3D force-moment measurements during orthodontic therapy. Quantitative knowledge of the 3D force-moment systems applied for therapeutic tooth movement is of utmost importance with regard to the predictability of tooth movement and the reduction of traumatic side-effects such as dental root resorption. Telemetric components for data and energy transmission are currently being integrated into the smart brackets to enable their future clinical application. We have also been able to realize a smart dentition which is currently applied in vitro for investigating force-moment systems exerted on the individual teeth during simulated treatment situations.

Patient care in our clinic covers the correction of dental malocclusion in children and adults. In collaboration with other departments, we also treat patients with significant dental disproportions, which require both orthodontics and orthognathic surgery, and patients with cleft lip and palate. Furthermore, we are specialized in the diagnosis and treatment of the dental problems of wind instrumentalists.
Co-opted:

Institute of Laser Technology in Medicine and Metrology (ILM)

Head of Institute: Prof. Dr. Raimund Hibst
Keywords: Laser | optics | bio photonics | applied research

ILM is an independent institute that is both local to and closely associated with Ulm University. Its mission is dedicated to applied research and the transfer of developed technologies into industrial and medical practice. Its basic financing is supplied by the Ministry of Finance and Economics of Baden-Württemberg and supplemented by annual donations from founder companies. The major part (two thirds) of the budget is acquired by means of various projects. With a further eleven institutions ILM represents the Innovationsallianz (Innovation Alliance) Baden-Württemberg. Currently, ILM has roughly fifty employees (including eleven PhD students) in addition to five to ten students. Its annual budget totals approximately four million euros.
From its initial research into laser medicine, ILM has since developed into a much broader institute of applied photonics and optics. Focusing on a set of core competences, applications are multifaceted. They cover medical/dental diagnostic tools and therapeutic systems, such as an optical caries detector and a variety of medical laser systems, optical sensors for fast virus detection, food and tablet analysis, or snow profiling, as well as in-house developments of a photo-thermal tool for material inspection and of optical 3D topography devices for intraoral scanning or industrial metrology. The research spans from solving Maxwell’s equations in order to understand light propagation to clinical studies in the institute’s day clinic.

Selected Publications:
Co-opted: Institute of Psychology and Education

Institute of Psychology and Education
Kolassa Group: Clinical & Biological Psychology
Head of Group: Prof. Dr. Iris-Tatjana Kolassa

Keywords: Trauma | Molecular Psychology | Aging | Post-traumatic Stress Disorder | Genetics

The work group of Clinical and Biological Psychology is part of the Institute of Psychology and Education in the Faculty of Engineering and Computer Science. The team, headed by Prof. Dr. Iris-Tatjana Kolassa, who in addition is a co-opted member of the Medical Faculty, consists of eighteen members: two postdocs; fourteen doctoral students (two from abroad); and one medical technical assistant. 78% of the team are female. The research of the work group focuses on traumatic stress and its molecular consequences, the genetics of Post-traumatic Stress Disorder, psychological and biological factors in the transgenerational cycle of maltreatment, physical exercise and cognitive training in the prevention of cognitive aging, silver gaming and cognition, and electroencephalography in the assessment of indicators of consciousness in brain-injured patients. Furthermore, the team is currently establishing a Psychotherapeutical Outpatient Clinic for the treatment of disorders of the trauma spectrum that is headed by Dr. Roberto Rojas as psychotherapist and supervisor.

Selected Publications:
Aging of hematopoietic stem cells (HSCs) is associated with impaired hematopoiesis in the elderly. Despite a large amount of data describing the decline of HSC function upon aging, the molecular mechanisms of this process still remain largely unknown and this therefore precludes rational approaches to attenuate stem cell aging. The figure shows the analysis of mode and outcome of LT-HSCs division upon aging: symmetric and asymmetric divisions are observed.

Selected Publications: