**FACILITIES & OTHER RESOURCES**

**The Max Harry Weil Institute for Critical Care Research & Innovation**

Launched in 2015, the Max Harry Weil Institute for Critical Care Research & Innovation (formerly the Michigan Center for Integrative Research in Critical Care or MCIRCC) is a comprehensive research enterprise devoted to transforming critical care medicine through innovation, integration, and entrepreneurship and by accelerating transformational team science. The Weil Institute provides an innovative multidisciplinary research infrastructure designed to catalyze the translation of scientific discovery to the multiple interrelated disease platforms of critical illness and injury involving all age groups and patient populations. Areas of emphasis include sepsis and multiorgan failure, neurologic emergencies, critical heart conditions, and trauma and combat casualty care. The Weil Institute serves as the scientific home and platform for over 200 basic scientists, engineers, clinical investigators, data scientists, inventors, and entrepreneurs interested in the care of patients with life-threatening acute illness and injury. The resulting critical care community converges patient and clinical needs to accelerate discovery and innovation. The Weil Institute provides investigators with several core resources to lower barriers to team science and enhance technology development.

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**Weil Institute Pre-Clinical Critical Care Laboratory:** The Weil Pre-Clinical Critical Care Laboratory is a unique facility designed to produce best-in-class, high-fidelity large animal models of multisystem critical illnesses and injuries, such as polytrauma/hemorrhage, cardiac arrest, sepsis, burn injuries, acute respiratory distress syndrome, and traumatic brain injury, allowing for discovery and translational science as well as technology development. These models are available for integrated research projects and for developing new diagnostics, therapeutics, devices, and digital health solutions ready for clinical testing in critical care. The 2910-sq.-ft. large animal operating suite consists of two stations for non-survival surgery, four stations for survival surgery, two stations for recovery and intensive care, and two preparation rooms with separate entrances for surgeon prep and for animal prep/recovery. The lab is equipped with state-of-the-art high resolution physiologic and metabolic monitoring and analytic equipment providing for unique “physiomic” monitoring, tissue banking, and analysis for preclinical research. The lab is staffed with highly qualified and trained researchers, veterinarians, and technicians. *See equipment for this lab below.*

**Weil Institute Clinical Research Unit:**The Weil Clinical Research Unit assists investigators with all aspects of clinical research related to critical care. The Unit handles IRB submissions and ensures research is compliant with local and federal guidelines and regulatory requirements. They also perform all study recruitment, enrollment, and data collection activities. They have access to a 24/7 electronic surveillance system that immediately identifies and notifies the research team of Emergency Department or hospital patients that meet inclusion/exclusion criteria for specific studies. Once a study has been given endorsement to proceed, the Clinical Research Unit works with research teams to build an understanding of the patient population to target for data collection. Patients are carefully screened for inclusion criteria from internal and external sources, and eligible patients (or their legally authorized representative) are approached by a Unit coordinator for enrollment. After informed consent is obtained by a coordinator, the Clinical Research Unit collects samples and data, accesses medical record information, and de-identifies protected information so the data can be shared with the team. The Unit also has access to clinical lab space near the Emergency Department and ICUs for short-term sample storage and processing.

**Weil Institute Data Science Team and Big Data Platform:** The Weil Data Science Team includes both data operations specialists and data science and machine learning experts. The team helps researchers obtain and wrangle data, build cohorts, develop and validate machine learning models, and deploy and maintain those models. They also manage the Weil Big Data Platform, which collects, transforms, deidentifies, and stores real-time, continuous, high-resolution streaming data from over 500 monitored ICU beds in the U-M Hospital, where researchers can then access the data for their research needs. The platform collects both waveforms and numerics from various bedside monitors that provide physiologic data, including electrocardiograms (ECG), pulse oximetry, arterial catheter waveforms, heart rate, blood pressure, etc. Once the patient data is read in to the platform, a unique patient ID key is generated and stored on premise along with the patient’s encrypted medical record number so that the patient data can both be safely stored in the cloud and re-identified later for researchers with the correct IRB and permissions. This data can be used in conjunction with data from the U-M Research Data Warehouse, the Epic electronic medical record, and Epic electronic medical record point-of-care test sources, which provides lab values, medications, and other event-based data. The Big Data Platform obtains and aggregates patient data from these sources such as labs, medications, radiographic studies, and nurse validated vitals and then time aligns it with the waveform and numeric data. These data sources can be queried in near real time for current patients to feed machine learning algorithms or for retrospective searches to train predictive models.

**Weil Institute Product Commercialization Team:** The Weil Institute strives to move innovative and impactful innovations to the bedside as efficiently as possible. To achieve this, the Product Commercialization Team includes experienced entrepreneurs and product managers who help investigators navigate the challenge of taking an idea into the marketplace. Using proven methodologies, the team guides investigators through the critical steps between product ideation and product validation. They connect PIs with Mentors in Residence, manufacturing and prototyping resources, FDA consultants, and additional opportunities for follow-on funding. As the product nears its final pre-commercialization phase, the Product Commercialization Team collaborates with the Weil Communications Team to deliver high quality promotional materials, a product web page, and product demo videos. All key deliverables are created while proactively working with U-M Innovation Partnerships (the University’s technology transfer office) to maximize the product’s impact and chance for successful sale into the marketplace.

**Weil Institute Proposal Development Team:**The Weil Proposal Development Team assists researchers in finding research funding and developing grants for a variety of federal (NIH, DoD), foundation, and industry resources. Services include ensuring strategic alignment with funding agencies, facilitated brainstorming, project management, and grant editing. The Team’s goal is to help investigators and teams submit completive proposals and alleviate the administrative burden of grant submissions. The unit supports early-stage investigators, as well as experienced investigators submitting multidisciplinary applications, and they provide professional and intensive team science support to help plan and execute such complex multidisciplinary proposals.

**Weil Institute Communications, Grand Challenge, and Events Team:** The Weil Communications, Grand Challenge, and Event Unit designs and implements membership communications tools (including the Weil Institute website) as well as strategic innovation-based ideation sessions, engages with potential donors, and coordinates outreach strategies and educational events. Significant unit efforts include: (A) the Weil Institute Grand Challenge Program. This program supports high-impact proposals by funding milestone-driven research over a 12-month timeframe to accelerate critical care research from bench to bedside. This model offers donor and industry partners a rigorous framework to help innovative ideas reach their fullest potential. Past efforts have influenced advancements in critical care research, education, and patient treatment. The Unit supports these efforts by providing overall administration of events, competitions, program management, advertising campaigns, and collaborations with industry and external partners. (B) Development and implementation of print and digital communications collateral, including multi-page brochures on focused areas of critical care and Weil Institute initiatives and event presentations. (C) Management and administration of the Weil Institute’s online presence and social networking tools, including Twitter, the Weil Institute website, and a monthly newsletter to more than 500 recipients. (D) Management and operation of Weil Institute events, including a Visiting Scholar Seminar Series and a Re-Imagining Critical Care Seminar Series.

**EQUIPMENT**

**Weil Institute Pre-Clinical Critical Care Laboratory:** The Pre-Clinical Critical Care Laboratory has the following equipment available for large animal research:

* **Data Acquisition system:** MP160, A multichannel Data Acquisition System. (Biopac, Goleta, CA): The MP160 System hardware provides a flexible tool for research and teaching needs. The modular, powerful interface system can be used with BIOPAC amplifiers and accessories. Each MP System provides high resolution (16 bit), variable sample rates for analog and calculation channels, 16 analog inputs and two analog outputs, digital I/O lines, and 16 online calculation channels. Biopac modules can capture signals and collecting data for various blood and cavity pressures, ECG, EEG, breathing gas analysis, respiratory mechanics, temperature, bio-impedance, laser Doppler flow, and many other physiologic measures.
* **SurgiVet:** (Advisor® Vital signs Monitor)(Smiths Medical). Hemodynamics and surgical monitoring unit for ECG, heart rate, blood pressure, arterial oxygen saturation (SpO2), and end-tidal CO2.
* **Anesthesia machines/Ventilator:** Fabius GS premium (Dräger Medical Inc., Telford, PA). Anesthesia workstations are available. The machines feature a high-contrast color monitor with a Dräger user interface for easy and familiar operation. All major ventilation modes are available. The units are highly maneuverable and contain an integrated LED workplace illumination, solid, spacious design with large drawers and CLIC absorber compatible.
* **Electro-surgery and cautery:** (Bovie Medical Corporation, Tampa, FL). A high Frequency Desiccator with 60 watts of Cutting capabilities. The Desiccator is adjustable in increments in the first 10 watts and has a 3-Button Pencil to adjust power for the most accurate output available.
* **Temperature Control:** Blanketrol, (Cincinnati Sub-Zero Medical, Cincinnati, OH). A temperature management system for mild hypothermia treatment and to induced hypothermia. It features 3 hose connections and 3 operating modes: Automatic, Manual & Monitor Only, and Built-in storage drawer for manuals, probes, cables and more.
* **Blood gas analyzer:** ABL800 (Radiometer America, Westlake, OH) Using 95 to 195 µL of blood, ABL800 can measure up to 16 STAT parameters on the same blood sample. pH, blood gases (pCO2 and pO2), electrolytes (Cl-, Ca2+, K+ and Na+), metabolites (glucose and lactate) and oximetry (Hb, SO2, O2Hb, COHb, MetHb, HHb and HbF).
* **Blood chemistry analyzer:** VetScan (Abaxis, Union City, CA) Chemistry, electrolyte, immunoassay and blood gas analyzer. Using 100 µL sample size - whole blood, serum or plasma with a choice of 10 panels (Canine Wellness, Mammalian Liver, Avian/Reptilian Profile Plus, T4/Cholesterol, Kidney Profile Plus, Comprehensive Diagnostic’ Prep Profile II’ and Critical Care Plus profile). Collectively, these profiles measure ALB, ALP, ALT, AMY, AST, BA, BUN, Ca2+, CHOL, CHW, CK, CL-, CRE, GGT, GLOB, GLU, K+, Mg2+, Na+, PHOS, T4, TBIL, tCO2, TP, and UA.
* **Hematology analyzer:** VetScan HM5 (Abaxis, Union City, CA) Fully-automated, five-part differential hematology analyzer displaying a comprehensive 22 parameters (WBC, LYM, MON, NEU, BAS, EOS, LYM%, MON%, NEU%, EOS%, BAS%, RBC, HGB, HCT, MCV, MCH, MCHC, RDW, PLT, MPV, PCT, PDW) with cellular histograms on an easy-to-read touch-screen. VetScan HM5 uses 50 μL sample size and allows analysis of low-volume samples and replicating runs for small or young animals.

# Coagulopathy Analysis:

* + **Thromboelastograph® Hemostasis Analyzer System:** TEG 5000 with 2 independent measuring channels per analyzer (Haemonetics, Braintree, MA). A diagnostic instrument that provides comprehensive whole blood (360µL) hemostasis testing that can help assess bleeding and thrombotic risks, and also monitors antithrombotic therapies. TEG5000 analyzes Rate of clot formation, strength and stability of clot, effect of platelet, coagulation factor and cellular interactions, maximum platelet function, risk of hemorrhage and thrombosis, and identification of fibrinolysis.
  + **Thromboelastometry (TEM®):** ROTEM delta Hemostasis Analyzer with 4 channels (ROTEM, Raleigh, NC) Differential diagnosis capability when performing 4 test assays. Using 200µL, the device measures the interactions of coagulation factors, inhibitors and cellular components during the phases of clotting and subsequent lysis over time.
  + **STA Compact:** (Diagnostoca Stago, Parsippany, NJ). Provides simultaneous clotting, chromogenic and immunological assays with continuous sample loading. With 1 drawer of 96 primary sample tubes, STA compact is capable of performing 80 user’s defined tests including but not limited to PT, APTT, fibrinogen, thrombin time, extrinsic pathway factors, intrinsic pathway factors, heparin, D-dimers, antithrombin, Protein-C and Protein-S.
* **Continuous Cardiac Output:** Vigilance I Monitor. (Edwards Lifesciences, Irvine, CA) Continuous cardiac output, SvO2, EDV, SVR, and other measured and derived parameters are presented on customized displays selected by the clinician. Capable of interfacing with the bedside monitor for convenience and display of additional measured and derived parameters.
* **Microcirculation imaging system:** MicroScan (MicroVision Medical, Amsterdam, The Netherlands): The system is a handheld video microscope that uses side-stream dark field technology with LED illumination. It uses 5x-magnification to visualize microcirculation and capillaries. The system software can measure functional capillary density as well as red blood cell velocity.
* **Continuous Blood Flow Monitoring:** Transonic Blood flow monitor (Transonic, Ithaca, NY) and TS420 Perivascular Flowmeter Modules capable of continuous measurement of blood flow at four locations and different size vessels.

# Tissue Oxygenation Monitoring Options:

* + **Near Infrared Spectroscopy:** INVOS™ 5100 Cerebral/Somatic Oximeter. (Covidien, Mansfield, MA): The INVOS™ system provides real-time monitoring of changes in regional oxygen saturation (rSO2) of blood in the brain or other body tissues beneath the sensor for effective tissue hemoglobin oxygen monitoring in animals.
  + **Brain Tissue Oxygen Monitoring:** Licox® (Integra LifeSciences Corporation., Plainsboro, New Jersey). The Integra™ Licox® Brain Oxygen Monitoring System measures intracranial oxygen and temperature and is intended as an adjunct monitor of trends of these parameters, indicating the perfusion status of cerebral tissue local to sensor placement.
* **Imaging Equipment and Modalities:**
  + **Portable X-Ray Machine:** (Mini x-ray machine, Northbrook, IL). A small size x-ray machine with a computerized developer. Available 24/7.
  + **M9 MindRay Ultrasound Machine** including phased array, linear array and trans-esophageal probes.
* **Additional MRI facility at the Biomedical Engineering Department:** *In vivo* high field Animal Magnetic Resonance Imaging (MRI) Facility is equipped with a 7 Tesla MRI scanner from Agilent Technologies. This system has a 31 cm bore and has a 3-gradient system for larger animals, rats and mice, respectively, and supports a full range of MRI pulse sequences, including echo planar imaging and diffusion tensor imaging. The system also includes 4 transmit channels for parallel excitation and 4 receive channels, along with a wide array of RF coils, including coil arrays for parallel imaging. Full physiological monitoring, animal holders, rapid animal positioning systems, and an animal heater are available. The center is located half a mile from the University’s North Campus Research Complex (NCRC), and imaging is available by requests.
* **Outlets:** For Oxygen, compressed air, suction outlets, and overhead surgical lighting.
* **Surgical tools:** A full array of surgical tools (i.e., general, cardiac, and neuro surgeries).
* **Operating room tables:** Adjustable heated tables.
* **Two High Performance Computers: Equipped** with 52” monitors.