FCR 10

Office of the President
September 10, 2021

Members, Board of Trustees:

PATENT ASSIGNMENT REPORT

Recommendation: that the Board of Trustees accept the patent assignment report for the period April 1, 2021 to June 30, 2021.

Background: At its March 1997 meeting, the Board of Trustees authorized the University of Kentucky Research Foundation to conduct all future copyright and patent filings and prosecutions. Quarterly reports on patent and copyright applications are to be submitted to the Finance Committee of the Board.

Action taken: ☑ Approved ❑ Disapproved ❑ Other_____

PATENT ASSIGNMENTS
FOR THE PERIOD April 1, 2021 TO June 30, 2021

Patents

The following assignments on behalf of the Board of Trustees of the University of Kentucky Research Foundation have been executed:

1. **U.S. Patent Application Number:** 17/225,780
UKRFID: 2266
Filed: April 8, 2021
Title: REG3A AND REG FAMILY MEMBER BIOMARKERS AND METHODS FOR DIAGNOSIS AND TREATMENT OF CANCER
Inventors: Sabine Brouxhon (formerly College of Medicine), Ronald Bruntz (College of Medicine), Melvyn Yeoh, Matthew Hoover and Stephanos Kyrkanides (College of Dentistry)
Description and Application: A cancer treatment with human antibodies targeting regenerating islet-derived protein 3 alpha (Reg3A). Administration of human antibodies against Reg3A decreases viability of some cancer cells in culture, and coadministration of anti-Reg3A antibodies with gemcitabine (a common chemotherapeutic agent) decreases pancreatic cancer cell line growth past that of gemcitabine alone. The National Cancer Institute estimates 1,735,350 new cancer cases and 609,640 deaths in the United States in 2018.
License: N/A

2. **U.S. Patent Application Number:** 17/283,626
UKRFID: 2554
Filed: April 8, 2021
Title: ENDOGENOUS CYTOPLASMIC ALU COMPLEMENTARY DNA IN AGE-RELATED MACULAR DEGENERATION
Inventors: Jayakrishna Ambati, Benjamin Fowler, Kameshwari Ambati (formerly College of Medicine), Shinichi Fukuda, Bradley Gelfand and Nagaraj Kerur (University of Virginia)
Description and Application: A method for treating age-related macular degeneration by administering an effective amount of a reverse transcriptase (RTase) activity inhibitor. The RTase activity is cytoplasmic RTase activity. The inhibitor that reduces cytoplasmic accumulation of a reverse transcription product is a single-stranded Alu cDNA. In some embodiments, the inhibitor of RTase activity is selected from the group consisting of an L1 ORF2 inhibitor, a nucleoside reverse transcriptase inhibitor (NRT1), an alkylated derivative of an NRT1, and a non-nucleoside reverse transcriptase inhibitor (NNRT1). The global pharmaceutical market for age-related macular degeneration was worth $8.6 billion in 2018 and is expected to reach $18.7 billion in 2028.
License: N/A

3. **U.S. Patent Application Number:** 17/228,254
UKRFID: 2137
Filed: April 12, 2021
Title: APPARATUS AND METHOD FOR ENHANCING YIELD AND TRANSFER RATE OF A PACKED BED
Inventors: Bradley Irvin, Kunlei Liu and Roger Perrone (Center for Applied Energy Research)
Description and Application: A carbon capture system of an absorber with a lower gas inlet, an upper gas inlet, and an upper and lower solvent outlet for counterflow. A packed bed is placed between the outlets, and each packed bed includes a sonic transducer and a packed material. The sonic transducer may be located within the packed bed or on the outside of the packed bed. The use of the transducer increases the yield rate by between 21-40% from a packed bed in a two-phase reaction by applying sonic energy. The current global market for carbon capture and sequestration market is $1.7 billion with an expected CAGR of 19.2% until 2027.
License: N/A

4. **U.S. Patent Application Number:** 17/232,594
UKRFID: 2229
Filed: April 16, 2021
Title: PERCUTANEOUS PULMONARY ARTERY DRAINAGE DEVICE
Inventors: Dongfang Wang and Joseph Zwischenberger (College of Medicine)
Description and Application: A multiple lumen device for percutaneous left ventricular unloading during venoarterial extracorporeal membrane oxygenation. The device includes an expandable cage, an outer catheter and an inner catheter. The use of the device provides a method for causing blood of a patient to flow in a retrograde manner. Cardiogenic shock is a serious condition of reduced cardiac output with end organ hypoperfusion, resulting in mortalities as high as 40-50%. Venoarterial extracorporeal membrane oxygenation is a method of treatment that provides total circulatory support to extend patient life but is unable to unload the left ventricle in severe cardiogenic shock. The inventive device can unload the left ventricle during procedures facilitating myocardial recovery. The global heart assist device market is $1.7 billion and is expected to grow at a CAGR of 11.7%.
License: Exclusive license to W-Z Biotech, LLC

5. **U.S. Patent Application Number:** 17/242,989
UKRFID: 2452
Filed: April 28, 2021
Title: GUIDING SHEATH SYSTEM AND METHOD OF DELIVERING AN ENDOVASCULAR DEVICE USING THE SAME
Inventors: David Minion (College of Medicine)
Description and Application: A guiding sheath system with a hinge or a hinge-like connection at the end of the sheath directing and firmly maintaining the end of the sheath in a vector that is different than the remainder of the sheath. Guiding sheaths are tube-like devices designed to be placed with the distal end of the sheath positioned within the vasculature and the proximal end of the sheath kept

extracorporeal allowing for the introduction of endoluminal devices into the vasculature. The United States interventional cardiology device market size is more than $3 billion with an expected CAGR of 3.6% until 2026.
License: N/A

6. **U.S. Patent Application Number:** 17/308,895
UKRFID: 2486
Filed: May 5, 2021
Title: INHIBITING ANGIOTENSINOGEN TO ATTENUATE AORTIC PATHOLOGY IN MARFAN SYNDROME
Inventors: Alan Daugherty, Mary Sheppard, Hong Lu and Jeff Chen (College of Medicine)
Description and Application: A method of attenuating aortic pathology in a patient with Marfan syndrome by administering an effective amount of an angiotensinogen (AGT) antisense oligonucleotide (ASO) to reduce AGT plasma levels in the patient. This treatment reduces or inhibits the progression of aortic dilation either in the thoracic, aortic root or ascending aorta regions. Marfan syndrome is an autosomal dominant genetic disease caused by mutations in a large extracellular matrix protein. It has an incidence of approximately 1:3000 live births and is associated with increased morbidity and mortality for a significant number of affected patients.
License: N/A

7. **U.S. Patent Application Number:** 17/325,085
UKRFID: 2425
Filed: May 19, 2021
Title: ANTIBODIES FOR BINDING PATHOLOGIC FORMS OF CALCINEURIN
Inventors: Christopher Norris, Susan Kraner, Jenna Leigh Gollihue (College of Medicine) and Rodney Guttman (University of West Florida)
Description and Application: Monoclonal antibodies that label pathologic delta calcineurin (CN) fragments, but do not label full-length CN. In conjunction with immunohistochemistry, these antibodies can pinpoint where delta-CN is generated in relation to different cell types and developing neuropathology. Methods can then be used to identify which genes and proteins are mechanistically associated with delta-CN. In ELISA applications, delta-CN may be specifically identified and quantified in biofluids using these novel antibodies. This detection can be used in a clinical setting as a relatively non-invasive method of predicting the presence of an insidious pathology in the central nervous system. The global neurogenerative disease therapeutics market is expected to exceed $13 billion by 2022 with a CAGR of 8%.
License: N/A

8. **U.S. Patent Application Number:** 17/327,631
UKRFID: 2314
Filed: May 21, 2021
Title: USE OF NON-CODING NUCLEIC ACID FOR CROP IMPROVEMENT AND PROTECTION AGAINST MICROBES
Inventors: Pradeep Kachroo, Aarda Kachroo, Gah-Hyun Lim and Shine Baby (College of Agriculture, Food and Environment)
Description and Application: Compounds for conferring systemic acquired resistance (SAR) in plants, the compounds including a nucleotide sequence derived from trans-acting small interfering RNA3a (TAS3a). The compound is exogenously applied to the target plants. The compound includes specific sequences and modifications such as a ribose 2'/3'-ribose modification, a 3'-end modification, a locked nucleic acid (LNA), conjugation of nanoparticle (NP) or combinations thereof. SAR often leads to resistance at the whole plant level and involves the local generation of signal(s) at the primary infection site followed by their system transport throughout the plant. These signals then arm the distal uninfected portions against subsequent secondary infections. The global crop protection market is currently more than $70 billion with a CAGR of 5%.
License: N/A

9. **U.S. Patent Application Number:** 17/336,165
UKRFID: 2462
Filed: June 1, 2021
Title: COMPOUNDS AND METHODS FOR USE IN CONNECTION WITH OPIOID USE DISORDERS
Inventors: Chang-Guo Zhan, Fang Zheng and Chunhui Zhang (College of Pharmacy)
Description and Application: Compositions and methods for binding to opioids while avoiding binding to opioid use disorder (OUD) treatment agents. The compositions include monoclonal antibodies having the ability to bind with one, two or all three of the heroin-related opioids (6-MAM, morphine and heroin) without binding to naloxone or naltrexone. These compositions may also be used for screening and detection of opioid in a sample. Opioid drugs, especially heroin, are known as a growing national crisis in America due to the rapidly increasing overdose deaths. The global opioid use disorder market was $1.9 billion in 2018 and is expected to reach $4.8 billion by 2028.
License: N/A

10. **U.S. Patent Application Number:** 17/416,023
UKRFID: 2261
Filed: June 18, 2021
Title: CATHETER SYSTEMS AND RELATED METHODS
Inventors: Thomas Pittman (College of Medicine) and William Dillen (formerly College of Medicine)
Description and Application: A catheter system for accessing cerebrospinal fluid. The catheter system utilizes a rigid stylet that is inserted into the catheter system to

allow extraction of cerebrospinal fluid. The stylet further includes a groove at the distal end of the stylet to provide a tactile feedback to a surgeon inserting the catheter system. The catheter system can be used to form a closed reservoir that can be punctured with a needle to access the cerebrospinal fluid to allow delivery of therapeutic agents or removal of cerebrospinal fluid. The implantable port global market is expected to reach more than $9 billion by 2027.
License: In exclusive license negotiations with Alcyone

11. **U.S. Patent Application Number:** 17/362,265
UKRFID: 1835
Filed: June 29, 2021
Title: PROTECTION OF CELLS FROM DEGENERATION AND TREATMENT OF GEOGRAPHIC ATROPHY
Inventors: Jayakrishna Ambati (formerly College of Medicine)
Description and Application: A treatment for age-related macular degeneration (AMD). AMD is characterized by the degeneration of the retinal pigmented epithelium (RPE). The invention includes a method of protecting a cell by inhibiting one or more of P2X7, IRAK1 and/or IRAK4. The cell being protected can be an RPE cell, a retinal photoreceptor or a choroidal cell. The global AMD market is expected to attain a value of $8.9 billion by 2022. Surging geriatric population, growing pipeline of AMD therapeutics, increasing prevalence of chronic diseases, and rising healthcare expenditures are prominent drivers.
License: Exclusive license with Inflammasome Therapeutics, Inc.

12. **U.S. Patent Application Number:** 17/362,515
UKRFID: 2467
Filed: June 29, 2021
Title: DETECTION AND EXTRACTION OF PLASTIC CONTAMINANTS WITHIN WATER USING HYDROPHOBIC DEEP EUTECTIC SOLVENTS
Inventors: Jian Shi, Wenqi Li, Jameson Hunter, Yuxuan Zhang and Qing Shao (College of Engineering)
Description and Application: A method for the detection and extraction of plastic contaminants within a water sample by the introduction of a hydrophobic deep eutectic solvent (DES). Accumulation of micro- and nano-scale plastic particles (microplastics and nanoplastics) is the subject of increasing concern as their small size makes them hard to remediate using traditional methods. With sizes similar or even smaller than a cell, nanoplastics can penetrate the natural barriers and affect biological functions of plants, animals and humans. For the detection of plastic contaminants within a water sample, hydrophobic DES is introduced to the water sample. The hydrophobic DES is then examined for plastic contaminant enrichment. This same method can be used to extract more than 60% of the plastic contaminants from the water sample. The global plastic waste management market size is projected to reach $41 billion by 2027 with a CAGR of 3.1%.
License: N/A

13. International Application Number: PCT/US21/18194[1]
UKRFID: 2463
Filed: February 16, 2021
Title: COMPOSITIONS AND METHODS FOR TREATING MALARIA
Inventors: Rodney Kip Guy, Jared Hammill (College of Pharmacy), Spencer Knapp, Robert Barrows and Christopher Davis (Rutgers University)
Description and Application: A method of treating malaria with tetrahydrobenzonaphtyridine carbonanilide (TBN) derivatives and related pyrrolinones and hydrolysis products. These compounds are active against *Plasmodium falciparum* strains that are resistant to multiple drugs currently on the market. The compounds have been synthesized and tested for their potency in the 3D7 strains of *Plasmodium falciparum*. No compounds have shown significant cytotoxicity. Malaria is a prevalent disease that continues to infect millions of people every year. In 2017, there were approximately 219 million cases and 435,000 deaths worldwide. The deadliest species for humans is *Plasmodium falciparum*.
License: N/A

14. International Application Number: PCT/US21/34279
UKRFID: 2449
Filed: May 26, 2021
Title: IDENTIFYING RISK OF CEREBRAL EDEMA
Inventors: Keith Pennypacker, Justin Fraser (College of Medicine) and Qiang Cheng (College of Engineering)
Description and Application: Methods and devices to identify risk factors of cerebral edema and severe infarct volume in a stroke patient. Each year approximately 800,000 individuals have a stroke, of which 87% are ischemic. Ischemic stroke remains one of the most debilitating diseases and is the fifth leading cause of death in the United States. A device for use in identifying risk of cerebral edema includes a combination of probes specific for a panel of cytokines and chemokines. The device can be a microfluidic enzyme-linked immunosorbent assay device. The global stroke management market is estimated to reach $23 billion by 2023 with a CAGR of 7.1%.
License: N/A

15. International Application Number: PCT/US21/35470
UKRFID: 2478
Filed: June 2, 2021
Title: ANTIVIRAL MASK AND ANTIVIRAL FILTER MADE FROM A BREATHABLE MICROPOROUS POLYMERIC MEMBRANE
Inventors: Dibakar Bhattacharyya (College of Engineering)
Description and Application: An antiviral mask or filter having a microporous membrane. The microporous membrane may have a thickness between about 30 and 500 microns, a porosity between about 20% and 80%, and an average pore size

[1] This application was filed by Rutgers University, records of the filing were received in July 2021.

of between about 15nm and 30nm. The pores may be functionalized with a proteolytic enzyme and virus denaturing agents. The development of smart filtration materials with lower air-flow resistance to remove airborne nanoparticles and virus particles will provide immense human health and industrial workplace benefits. The global personal protective equipment market is currently $51 billion with a CAGR of 6.7% until 2027.
License: N/A

16. **International Application Number:** PCT/US21/37796
UKRFID: 2451
Filed: June 17, 2021
Title: SUBTALAR ARTHRODESIS NAIL IMPLANT SYSTEM
Inventors: Arun Aneja, Gavin Hautala, Arjun Srinath (College of Medicine) and Lorenzo Deveza (Baylor College of Medicine)
Description and Application: A subtalar nail implant system with a subtalar nail, a spacer adapted to fit in a subtalar joint, and a plurality of fasteners to secure the nail to the talus and to the calcaneus across the subtalar joint. The nail implant system also includes a trial, with a wedge shape and a cooperating guidewire outrigger. When the trial is positioned in the subtalar joint, the guidewire outrigger is adapted for placement of a guidewire from the calcaneus into the talus through a guidewire receiver in the trial. This device addresses primary and revision subtalar arthrodesis surgery for arthritic conditions and calcaneal fractures. Current state-of-the-art treatment requires non-weight-bearing on the affected extremity while healing. This novel implant allows for a more stable fusion construct, compression at the fusion site and immediate weight-bearing. The global market for foot and ankle devices is $1.6 billion with a CAGR of 8%.
License: N/A

17. **International Application Number:** PCT/US21/39379
UKRFID: 2453
Filed: June 28, 2021
Title: METHOD OF FUSING A TIBIOTALAR JOINT AND FUSED TIBIOTALAR JOINT
Inventors: Arun Aneja, Arjun Srinath, Eric Abbenhaus (College of Medicine) and Lorenzo Deveza (Baylor College of Medicine)
Description and Application: A method for fusing a tibiotalar joint of a patient with an intramedullary device while leaving adjacent talocalcaneal or subtalar joint intact. The method includes placing an intramedullary nail through a talus and into a tibia of the patient without violating a posterior facet of the adjacent subtalar joint and fixing the intramedullary nail to the talus and the tibia. The incidence of geriatric ankle fractures is increasing with the aging population, and there is no consensus on the optimal management of these fractures. Current treatment methods of open reduction are invasive and require prolonged periods of immobilization. A tibiotalar nail would allow for fracture stabilization and immediate weight bearing. The global market for foot and ankle devices is $1.6 billion with a CAGR of 8%.
License: N/A

Patent Activities
Fiscal year to date as of June 30, 2021

Total FY2020-21					
	FY21Q1	FY21Q2	FY21Q3	FY21Q4	Total FY21
Invention Disclosures[i]	26	18	25	30	99
Full Patent Applications[ii]	23	16	22[2]	16	77
Provisional Patent Applications[iii]	26	17	19	18	80
Patents Issued	8	8	4	2	22
License Income[iv]	$810,900.86	$209,591.78	$1,250,404.62	$81,934.69	$2,352,831.95
New Licenses and Options Executed	6	3	11	7	27
New UK Startups Formed	0	0	5	1	6

[2] Number of Full Patents Applications for Q3 changed to capture undisclosed filing.

Patent Activities
FY2019-20 as of June 30, 2020

Total FY2019-20					
	FY20Q1	FY20Q2	FY20Q3	FY20Q4	Total FY20
Invention Disclosures[i]	22	32	33	33	120
Full Patent Applications[ii]	11	16	13	21	61
Provisional Patent Applications[iii]	28	14	25	32	99
Patents Issued	7	11	7	8	33
License Income	$1,365,221.64	$66,754.90	$1,478,971.84	$32,673.12	$2,943,621.50
New Licenses and Options Executed	12	4	7	6	29
New UK Startups Formed	1	0	2	3	6

Patent Application Summary Table

Inventors	College(s)	Title	Brief description
Biomedical			
Sabine Brouxhon, Ronald Bruntz, Melvyn Yeoh, Matthew Hoover and Stephanos Kyrkanides	Medicine, Dentistry	Reg3A and Reg family member biomarkers and methods for diagnosis and treatment of cancer	A cancer treatment with human antibodies targeting regenerating islet-derived protein 3 alpha.
Jayakrishna Ambati, Benjamin Fowler, Kameshwari Ambati, Shinichi Fukuda, Bradley Gelfand and Nagaraj Kerur	Medicine	Endogenous cytoplasmic ALU complementary DNA in age-related macular degeneration	A method for treating age-related macular degeneration by administering a reverse transcriptase activity inhibitor.
Dongfang Wang and Joseph Zwischenberger	Medicine	Percutaneous pulmonary artery drainage device	A multiple lumen device for percutaneous left ventricular unloading during extracorporeal membrane oxygenation.
David Minion	Medicine	Guiding sheath system and method of delivering an endovascular device	A guiding sheath system with a hinge or a hinge-like connection at the end of the sheath directing and firmly maintaining the end of the sheath in a different vector than the rest of the sheath.
Alan Daugherty, Mary Sheppard, Hong Lu and Jeff Chen	Medicine	Inhibiting angiotensinogen (AGT) to attenuate aortic pathology in Marfan syndrome	A method of attenuating aortic pathology in a patient with Marfan syndrome by administering an angiotensinogen antisense oligonucleotide to reduce AGT plasma levels in the patient.

Christopher Norris, Susan Kraner, Jenna Leigh Gollihue and Rodney Guttman	Medicine	Antibodies for binding pathologic forms of calcineurin	Monoclonal antibodies that label pathologic delta calcineurin fragments, but do not label full-length CN.
Chang-Guo Zhan, Fang Zheng and Chunhui Zhang	Pharmacy	Compounds and methods for use in connection with opioids use disorders	Compositions and methods that bind to opioids while avoiding binding to opioid use disorder treatment agents.
Thomas Pittman and William Dillen	Medicine	Catheter systems and methods	A catheter system for accessing cerebrospinal fluid.
Jayakrishna Ambati	Medicine	Protection of cells from degeneration and treatment of geographic atrophy	A treatment for age-related macular degeneration by inhibiting one or more of P2X7, IRAK1 and/or IRAK4.
Rodney Kip Guy, Jared Hammill, Spencer Knapp, Robert Barrows and Christopher Davis	Pharmacy	Compositions and methods for treating malaria	A method of treating malaria with tetrahydrobenzonaphtyridine carbonanilide derivatives and related pyrrolinones and hydrolysis products.
Keith Pennypacker, Justin Fraser and Qiang Cheng	Medicine, Engineering	Identifying Risk of Cerebral Edema	Methods and devices to identify risk factors of cerebral edema and severe infarct volume in a stroke patient.
Arun Aneja, Gavin Hautala, Arjun Srinath and Lorenzo Deveza	Medicine	Subtalar arthrodesis nail implant system	A subtalar nail implant system with a subtalar nail, a spacer adapted to fit in a subtalar joint, and a plurality of fasteners to secure the nail to the talus and to the calcaneus across the subtalar joint.
Arun Aneja, Arjun Srinath, Eric Abbenhaus and Lorenzo Deveza	Medicine	Method of fusing a tibiotalar joint and fused tibiotalar joint	A method for fusing a tibiotalar joint of a patient with an intramedullary device while leaving adjacent talocalcaneal or subtalar joint intact.

Engineering			
Bradley Irvin, Kunlei Liu and Roger Perrone	CAER	Apparatus and method to enhance yield and transfer rate of a packed bed	A carbon capture system of an absorber with a lower gas inlet, an upper gas inlet, and an upper and lower solvent outlet for counterflow.
Jian Shi, Wenqi Li, Jameson Hunter, Yuxuan Zhang and Qing Shao	Engineering	Detection and extraction of plastic contaminants within water using hydrophobic deep eutectic solvents	A method for the detection and extraction of plastic contaminants within a water sample by the introduction of a hydrophobic deep eutectic solvent.
Dibakar Bhattacharyya	Engineering	Antiviral mask and antiviral filter made from a breathable microporous polymeric membrane	An antiviral mask or filter with a microporous membrane to filter nanoparticles and virus particles.
Agriculture, Food and Environment			
Pradeep Kachroo, Aarda Kachroo, Gah-Hyun Lim and Shine Baby	Agriculture, Food and Environment	Use of non-coding nucleic acid for crop improvement and protection against microbes	Compounds for conferring systemic acquired resistance in plants, the compounds including a nucleotide sequence derived from trans-acting small interfering RNA3a.
Arts and Sciences			

[i] Invention disclosures include new technologies and intellectual property disclosed to the Office of Technology Commercialization (OTC) that do not fall under an existing technology number. This number captures the potential new intellectual property disclosed to OTC.

[ii] Full patent applications, as used by OTC, include nonprovisional patent applications filings at the United States Patent and Trademark Office (USPTO), Patent Cooperation Treaty filings, and foreign patent application filings. These are technologies that are assigned to the University of Kentucky that OTC has identified to invest further into in an effort to obtain patent protection and are described in more detail in the patent assignment section above.

[iii] Provisional patent applications are legal documents filed at the USPTO that establish a filing date and protect the owner from anticipated publication of the technology, but do not mature into an issued patent unless the applicant files a full patent application within one year. Although owned by the University of Kentucky, the provisional patent applications are not included in the patent assignment descriptions as they will not mature into full patent applications without further action and investment.

[iv] In Q2 an additional $300,000.00 was received from a license to 22nd Century managed by the College of Agriculture, Food, and Environment on behalf of the Office of Technology Commercialization.