BIOGRAPHICAL SKETCH

NAME	POSITION TITLE
Grzegorz Bulaj	Associate Professor of Medicinal Chemistry
eRA COMMONS USER NAME GREGBULAJ	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	YEAR(s)	FIELD OF STUDY
University of Wroclaw, Poland	M.Sc.	1989	Biochemistry
University of Wroclaw, Poland	Ph.D.	1993	Biophysical Chemistry

A. Personal statement

My research is focused on integrating pharmacological and behavioral therapies for chronic diseases by combining pharmaceutical drugs and digital medicine (mobile medical apps and therapeutic video games). Advancing this new paradigm has been enabled by the US Food and Drug Administration (FDA) clearing mobile medical apps and video games via software as medical device (SaMD) mechanism. Digital medicine comprises digital health, mobile health (mHealth), telemedicine, and is a relatively new term describing applications of mobile software, internet and wearables for medical and health purposes. SaMD has opened new opportunities for drug-device combination products consisting of pharmaceutical drugs and matching mobile apps and video games delivering disease-specific self-management and self-care.

One example of my research project is development of the mobile video game therapy for pediatric oncology patients undergoing the chemotherapy (feasibility clinical trial is ongoing). Other two examples are: (1) development of mobile software as adjunct medical treatment for epilepsy patients, and (2) music streaming as adjunct therapy for depression. All these projects are leading toward the FDA regulatory clearance for these technologies, so they may be prescribed by doctors and reimbursed by healthcare insurance companies. My long-term goal is to combine digital medicine, precision medicine and prescription medications, yielding new therapies for epilepsy, pain, depression, cancer and other chronic medical conditions.

With 17 years of experience in preclinical and clinical development of drug-based therapies, entrepreneurship activities, I greatly appreciate an opportunity to advance preclinical studies related to digital medicine using neuroactive enriched environment (described in this grant proposal). My research is cross-disciplinary and highly collaborative, in which medicine, art, software engineering, legal (IP), regulatory, educational, behavioral therapy and all translational components are of equal importance.

My research in digital medicine is coupled with public service via entrepreneurial and educational activities. I co-founded a start-up company Epicadence, Public Benefit Corporation, focused on commercializing mobile software as treatment of seizures in epilepsy patients. Recently, I launched an educational website UpMusic.net to increase public awareness about digital medicine technologies.

B. Positions and Honors

Positions and Employment

1991-1992	Research Associate, Paul-Ehrlich-Institute, Frankfurt/Main, Germany
1993	Short-Term Fellow, Basel Institute for Immunology, Basel, Switzerland
1993-1994	Research and Teaching Asst., Institute of Biochemistry, Univ. of Wroclaw, Poland
1994	Research and Teaching Adjunct, Institute of Biochemistry and Molecular Biology, University of Wroclaw, Poland
1994-1998	Postdoctoral Fellow, Department of Biology, University of Utah

1998 - Present	Research Assistant Professor, Department of Biology, University of Utah
1999 - 2000	Consultant, Cognetix, Inc., Salt Lake City, Utah
2000 - 2002	Senior Research Scientist, Cognetix, Inc., Salt Lake City, Utah
2002 - 2005	Director, Peptide Chemistry, Cognetix, Inc., Salt Lake City, Utah
2006 - 2010	Assistant Professor, Department of Medicinal Chemistry, University of Utah
2010- Present	Associate Professor, Department of Medicinal Chemistry, University of Utah

C. Contribution to Science

1. My earlier research on discovering and engineering marine peptide natural products resulted in two major contributions: new oxidative folding methods and creating a novel group of disulfide-rich and analgesic peptides containing unique backbone modifications. Steiner et al (2012) describes an original idea and successful examples of forming bioactive conformation of disulfide-rich peptides without reagents. Green et al (2007) describes an original idea of engineering backbone prosthesis in bioactive natural products, leading to improved analgesic activities in an animal model of inflammatory pain.

   Steiner AM, Woycechowsky KJ, Olivera BM, Bulaj G (2012) Reagentless Oxidative Folding of Disulfide-Rich Peptides Catalyzed by an Intramolecular Diselenide. ***Angew Chem Int Ed Engl,*** 51, 5580-4.

   Green BR, Catlin P, Zhang MM, Fiedler B, Bayudan W, Morrison A, Norton RS, Smith BJ, Yoshikami D, Olivera BM, Bulaj G (2007) Conotoxins containing nonnatural backbone spacers: cladistic-based design, chemical synthesis, and improved analgesic activity. ***Chem Biol****.* 14: 399-407.

2. I have developed a new research and development (R&D) program on engineering anticonvulsant analogs to cross the blood-brain barrier. This project resulted in several successful funding applications including the NIH R21 and U01 grants for which I served as PI and Co-PI. This research yielded one issued US patent and a first-in-class drug lead for refractory epilepsy, currently in preclinical IND-enabling studies. Bulaj et al (2008) described an original idea of improving bioavailability of neuropeptide analogs to cross the blood-brain barrier (BBB). Zhang et al (2013) describes an original idea of engineering first-in-class analgesic compounds that do not penetrate the CNS and are active in the inflammatory pain models. This research was recently recognize by the Department of Defense by awarding the grant to advance preclinical studies of these new analgesic drug candidates. Green et al (2011) describes an original idea of repurposing neuropeptides to discover new antiepileptic drug candidates.

   Bulaj G, Green BR, Lee HK, Robertson CR, White K, Zhang L, Sochanska M, Flynn SP, Adkins Scholl E, Pruess TH, Smith MD, White HS (2008) Design, Synthesis and Characterization of High-Affinity, Systemically-Active Galanin Analogs with Potent Anticonvulsant Activities, ***J Med Chem***, 51, 8038-47.

   Green BR, Smith M, White K, White HS, Bulaj G (2011) Analgesic Neuropeptide W Suppresses Seizures in the Brain Revealed by Rational Repositioning and Peptide Engineering, ***ACS Chem Neurosci*****,** 2, 51-56.

   Zhang L, Klein BD, Metcalf CS, Smith MD, McDougle DR, Lee HK, White HS, Bulaj G (2013) Incorporation of monodisperse oligoethyleneglycol amino acids into anticonvulsant analogues of galanin and neuropeptide y provides peripherally acting analgesics. ***Mol Pharm*****.** 10:574-85.

   Metcalf CS, Smith MD, Klein BD, McDougle DR, Zhang L, Bulaj G (2017) Preclinical Analgesic and Safety Evaluation of the GalR2-preferring Analog, NAX 810-2. ***Neurochem Res.*** 42: 1983-1994

3. My latest contribution to science is creating and advancing a concept of molecular-behavioral combination therapies for chronic diseases delivered via drug-device combination products. This strategy involves design and creation of mobile medical software (apps and games) to be integrated

with specific pharmaceutical drugs, described in a reference below Bulaj (2014). The inspiration for this paradigm came as a direct result of the collaborative project with Prof. Bruggers when developing the Patient Empowerment exercise video game for cancer patients. The clinical application of mobile games to empower patients by engaging them with physical exercises received additional support in 2014 when the FDA cleared two video games as medical devices for neurorehabilitation, This breakthrough has opened a possibility that our exercise-empowerment mobile game therapy can also become a medical device in the future, and can serve as add-on treatment with and after the chemotherapy. These opportunities are described in Bruggers at al (2012) and Govender et al (2015). Over the past two years, I have also been developing mobile app based therapy for the treatment of seizures in epilepsy patients: this collaborative project together with Professors Pegah Afra (Department of Neurology), Carol Bruggers (Department of Pediatrics) and Matt Sweney (Department of Pediatrics and Neurology) from the University of Utah. We just finished a survey-based clinical study with epilepsy patients and the manuscript will be submitted soon.

Bruggers CS, Altizer RA, Kessler RR, Caldwell CB, Coppersmith K, Warner L, Davies B, Paterson W, Wilcken J, D'Ambrosio TA, German ML, Hanson GR, Gershan LA, Korenberg JR, Bulaj G (2012) Patient-empowerment interactive technologies. ***Sci Transl Med.*** 4(152):152ps16.

Govender M, Bowen RC, German ML, Bulaj G, Bruggers CS (2015) Clinical and Neurobiological Perspectives of Empowering Pediatric Cancer Patients Using Videogames. ***Games Health J.*** 4: 362-374.

Bulaj G (2014) Combining non-pharmacological treatments with pharmacotherapies for neurological disorders: a unique interface of the brain, drug–device, and intellectual property. ***Front Neurol.*** 5:126.

Schriewer K and Bulaj G (2016) Music Streaming Services as Adjunct Therapies for Depression, Anxiety and Bipolar Symptoms: Convergence of Digital Technologies, Mobile Apps, Emotions, and Global Mental Health. ***Front Public Health***. 4: 217.

Bulaj G, Ahern MM, Kuhn A, Judkins ZS, Bowen RC, Chen Y (2016) Incorporating Natural Products, Pharmaceutical Drugs, Self-care and Digital/Mobile Health Technologies into Molecular-Behavioral Combination Therapies for Chronic Diseases. ***Current Clinical Pharmacology***, 11:128-45

Complete List of Published Work in MyBibliography:
http://www.ncbi.nlm.nih.gov/myncbi/browse/collection/49350580/?sort=date&direction=descending

D. Research Support

Ongoing Research Support

W81XWH-15-1-0380 (White, H.S. PI) 09/30/2015 – 08/31/2017
Department of Defense, Novel Systemically-Active Galanin Analogs for the Treatment of Pain
Role: Co-PI

P01 GM48677 (Olivera, B.M., Program Director) 7/1/2014 – 6/30/2019
NIH/NIGMS, in Project III: "Conopeptides that target voltage-gated sodium channels"
Discovery of conopeptides blocking sodium channels.
Role: Co-Investigator

Completed Research Support

U01 NS066991 (White, H.S. Principal Investigator) 9/1/2010-8/31/2015
NIH/NINDS, Development of a galanin-based therapy for the treatment of refractory epilepsy
The major goal of this project was a preclinical development of galanin-based analogs as antiepileptic drugs.
Role: Co-PI