## BIOGRAPHICAL SKETCH

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NAME: Michael Heung

eRA COMMONS USER NAME (credential, e.g., agency login): mheung

POSITION TITLE: Clinical Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

| INSTITUTION AND LOCATION | DEGREE *(if applicable)* | Completion Date MM/YYYY | FIELD OF STUDY |
|---|---|---|---|
| Boston University, Boston, MA | BA | 05/1995 | Medical Sciences |
| Boston University School of Medicine (BUSM), Boston, MA | MD | 05/1999 | Medicine |
| University of Cincinnati Hospitals, Cincinnati, OH | | 06/2002 | Internal Medicine Residency |
| University of Cincinnati Hospitals, Cincinnati, OH | | 06/2003 | Internal Medicine Chief Residency<br>Nephrology Fellowship |
| University of Michigan Health Systems, Ann Arbor, MI | | 06/2005 | |
| University of Michigan School of Public Health, Ann Arbor, MI | MS | 04/2011 | Clinical Research Design and Statistical Analysis |

### A. Personal Statement

My background includes clinical and administrative expertise in the area of AKI. For 10 years I served as the Medical Director of the Acute Dialysis Program at a large academic medical center, and I currently serve as the Associate Chief for Clinical Affairs in the Division of Nephrology. As a clinical researcher, my projects have included both clinical trials (pharmacokinetic, biomarker, and interventional) and outcomes studies in AKI patients. As a co-investigator at the University of Michigan Kidney Epidemiology and Cost Center (UM-KECC), I have worked on 3 federally-funded projects: the CDC CKD Surveillance System, Development of a Comprehensive National Kidney Disease Registry for the Department of Veterans Affairs, and the United States Renal Data System. For each of these projects, I served as lead investigator for studies in the area of AKI. I also serve as PI on a VA-funded grant exploring AKI risk prediction and prevention. My expertise in the area of AKI has been recognized by my selection to the American Society of Nephrology (ASN) AKI Advisory Group in 2014, and more recently by my appointment as co-director for the ASN's Critical Care Nephrology course starting in 2017. I have actively mentored current Kidney research Training Program T32 DK007378 trainees most recently including Dr. Sohanney and I look forward to mentoring KUHR trainees interested in AKI research.

Ongoing and recently completed projects that I would like to highlight include:

Watermark Research Partners
Heung (PI)
03/04/2013-06/30/2022 (NCX)
CRRT Network: Multi-center Observational Trial of Patients Undergoing Continuous Renal Replacement Therapy

Blue Cross Blue Shield
Heung (PI)
10/01/2020-12/31/2025
MKIC/Kidney Partnering CQI

No Number
Veinot (PI), Role: Co-Investigator
11/1/2016-10/31/2021
Enhancing the cardiovascular safety of hemodialysis care: a cluster-randomized, comparative effectiveness

## B. Positions and Honors

Academic Appointments

| | |
|---|---|
| 2005-2006 | Lecturer, Nephrology Division, Department of Internal Medicine, University of Michigan Medical School |
| 2006-2009 | Clinical Instructor, Nephrology Division, Department of Internal Medicine, University of Michigan Medical School |
| 2009-2014 | Clinical Assistant Professor, Nephrology Division, Department of Internal Medicine, University of Michigan Medical School |
| 2014-2019 | Clinical Associate Professor, Nephrology Division, Department of Internal Medicine, University of Michigan Medical School |
| 2019- | Clinical Professor, Nephrology Division, Department of Internal Medicine, University of Michigan Medical School |

Clinical Appointments

| | |
|---|---|
| 2006-2007 | Acting Chief, Nephrology Section, Ann Arbor Veterans' Affairs Medical Center |
| 2006-2016 | Medical Director, Inpatient Dialysis Services/Acute Dialysis Program, University of Michigan Health System |
| 2016-present | Associate Chief for Clinical Affairs, Division of Nephrology, University of Michigan |

Other Experience and Professional Memberships

| | |
|---|---|
| 2009-present | University of Michigan Nephrology Fellowship Curriculum Committee |
| 2009-present | University of Michigan Division of Nephrology Quality Improvement Committee |
| 2010-2012 | University of Michigan Department of Medicine Clinical Excellence Workgroup |
| 2012-present | Annual Scientific Meeting Planning Committee, Michigan State Medical Society |
| 2012-present | University of Michigan Department of Medicine Education Committee |
| 2012-present | Editorial board, Advances in Chronic Kidney Disease |
| 2016-present | Associate Editor, Advances in Chronic Kidney Disease |
| 2014-2017 | Renal Research Institute Research Board |
| 2014-2016 | Annual conference planning committee, ASAIO |
| 2014-2017 | American Society of Nephrology Acute Kidney Injury Advisory Group |
| 2017-present | American Society of Nephrology Kidney Week Critical Care Nephrology Precourse Co-Director |

Honors

| | |
|---|---|
| 2001 | Gold Foundation Award for Humanism and Excellence in Teaching, University of Cincinnati School of Medicine |
| 2002 | Alpha Omega Alpha Honor Medical Society, University of Cincinnati |
| 2009 | Faculty Teaching Award, Division of Nephrology, University of Michigan |
| 2009 | H. Marvin Pollard Award for Outstanding Teaching of Residents, Department of Medicine, University of Michigan |
| 2011 | National End-Stage Renal Disease Patient Safety Improvement Award, Renal Physicians Association |
| 2013 | *Academiae Laureati Medici* Clinical Excellence Society, Department of Medicine, University of Michigan |
| 2014 | Richard D. Judge Award for Excellence in Medical Student Teaching, Department of Medicine, University of Michigan |
| 2018 | Fellow, American Society of Nephrology |

## C. Contribution to Science

1. ***Contribution of Acute Kidney Injury to Chronic Kidney Disease:*** AKI is a common and often devastating complication among hospitalized patients. In recent years there has been increased recognition of the role of AKI in contributing to future adverse renal outcomes, including development (or progression) of CKD and even ESRD. My work in this area has included a comprehensive examination of renal outcomes following AKI (as defined by consensus serum creatinine-based classification scheme) in the Veterans Affairs population, which is now a USRDS data source. I have also examined predictors of recovery from severe (dialysis-requiring AKI), and recently have been exploring the impact of policy changes on this area.
    a. Heung M, Steffick DE, Zivin K, Gillespie B, Banerjee T, Hsu C-y, Powe NR, Pavkov ME, Williams D, Saran R, Shahinian VB; Centers for Disease Control and Prevention CKD Surveillance Team. Acute kidney injury recovery pattern and subsequent risk of chronic kidney disease: an analysis of Veterans Health Administration data. American Journal of Kidney Diseases 2016;67(5):742-52. PMID 26690912.
    b. Hsu R, McCulloch C, Heung M, Saran R, Shahinian V, Pavkov M, Burrows N, Powe N, Hsu C-y. Exploring potential reasons for the temporal trend in dialysis-requiring AKI in the United States. Clinical Journal of the American Society of Nephrology 2016;11(1):14-20. PMID 26683890.
    c. Pajewski R, Gipson P, Heung M. Predictors of post-hospitalization recovery of renal function among patients with acute kidney injury requiring dialysis. Hemodialysis International 2018;22(1):66-73. PMID 28296033.
    d. Kovesdy CP, Naseer A, Sumida K, Molnar MZ, Potukuchi PK, Thomas F, Streja E, Heung M, Abbott KC, Saran R, Kalantar-Zadeh K. Abrupt decline in kidney function precipitating initiation of chronic renal replacement therapy. Kidney International Reports 2017;3(3):602-9. PMID 29854967.

2. ***Quality Improvement Efforts in Dialysis***: There has been a relative paucity of literature describing quality improvement efforts in the dialysis arena, yet this is a complicated population that is at risk for adverse events and poor outcomes. As a dialysis medical director and now associate division chief, I have had a longstanding professional interest – and obligation – in coordinating quality improvement efforts and promoting patient safety. In recent years, I have overseen completion and publication of several projects. For each of these projects, I was the primary lead investigator and oversaw all phases including design, implementation, analysis and writing.
    a. Heung M, Adamowski T, Segal JH, Malani PN. A successful approach to fall prevention in an outpatient hemodialysis center. Clinical Journal of the American Society of Nephrology 2010; 5(10):1775-1779. PMID: 20595694. PMCID: PMC2974376.
    b. Talley CL, Wonnacott RO, Schuette JK, Jamieson J, Heung M. Extending the benefits of early mobility to critically ill patients undergoing continuous renal replacement therapy: the Michigan experience. Critical Care Nursing Quarterly 2013; 36(1):89-100. PMID: 23221445.
    c. Benfield CB, Brummond P, Lucarotti A, Villarreal M, Goodwin A, Wonnacott R, Talley C, Heung M. Applying lean principles to continuous renal replacement therapy processes. American Journal of Health System Pharmacy 2015;72(3):218-23. PMID: 25596606.
    d. Al Rifai A, Sukul N, Wonnacott R, Heung M. Safety of arteriovenous fistulae and grafts for continuous renal replacement therapy: the Michigan experience. Hemodialysis International 2018;22(1):50-5. PMID 28295984.

3. ***Fluid Overload and Outcomes in Patients Requiring Acute Dialysis:*** The deleterious effects of fluid overload in patients with acute kidney injury were first recognized in pediatric patients. Over the past several years, I have worked with pediatric colleagues to extend the literature on the adverse effects of fluid overload, including studies examining the impact of subsequent fluid removal using dialysis. My role in these projects (references b-d below) has been as a mentor to pediatric nephrology fellows, and I participated in all phases of the projects. In addition, I have brought attention in this area in the adult population. My study linking fluid overload to subsequent renal prognosis (reference a below) has been cited at several national conferences. I was the principal investigator for this study, and I participated in all aspects of the project.
    a. Heung M, Wolfgram D, Kommareddi M, Hu Y, Song PX, Ojo A. Fluid overload at initiation of renal replacement therapy is associated with lack of renal recovery in patients with acute kidney injury. Nephrology Dialysis Transplantation 2012;27(3):956-61. PMID: 21856761. PMCID: PMC3471547.

b. Selewski DT, Cornell TT, Lombel R, Blatt NB, Han YY, Mottes T, Kommareddi M, Kershaw DB, Shanley TP, Heung M. Weight-based determination of fluid overload status and mortality in pediatric intensive care patients requiring continuous renal replacement therapy. Intensive Care Medicine 2011; 37(7):1166-73. PMID: 21533569. PMCID: PMC3315181.
c. Lombel RM, Kommareddi M, Mottes T, Selewski DT, Han YY, Gipson DS, Collins KL, Heung M. Implications of different fluid overload definitions in pediatric stem cell transplant patients requiring continuous renal replacement therapy. Intensive Care Medicine 2012; 38(4):663-9. PMID: 22327560.
d. Selewski DT, Cornell TT, Blatt NB, Han YY, Mottes T, Kommareddi M, Gaies MG, Annich GM, Kershaw DB, Shanley TP, Heung M. Fluid overload and fluid removal in pediatric patients on extracorporeal life support requiring continuous renal replacement therapy. Critical Care Medicine 2012; 40(9):2694-9. PMID: 22743776. PMCID: PMC3423554.

4. ***Pharmacokinetics of Drugs in Patients Undergoing Acute or Chronic Dialysis:*** Many drugs (or their metabolites) are cleared by the kidneys, and therefore decreased renal function is an important factor in determining optimal drug dosing. Currently, most dosing guidelines in patients with chronic kidney disease (including end-stage renal disease on maintenance dialysis) are empiric or based on very small studies. This is particularly true in the setting of acute kidney injury, where in addition to dialysis issues, patients may have abnormal volumes of distribution and drug kinetics. I have had a longstanding collaboration with Dr. Bruce Mueller (a PharmD) to perform formal pharmacokinetic studies of various commonly used drugs in both the acute and chronic dialysis settings. These studies have helped better define appropriate dosing. My role in these studies has been to oversee patient recruitment and safety, and to help with study design and implementation.
    a. Salama NN, Segal JH, Churchwell MD, Patel JH, Gao L, Heung M, Mueller BA. Single dose daptomycin pharmacokinetics in chronic hemodialysis patients. Nephrology Dialysis Transplantation 2010; 25(4):1279-84. PMID: 20007981. PMCID: PMC2902860.
    b. Harder JL, Heung M, Vilay AM, Mueller BA, Segal JH. Carbamazepine and the active epoxide metabolite are effectively cleared by hemodialysis followed by continuous venovenous hemodialysis in an acute overdose. Hemodialysis International 2011; 15(3):412-5. PMID: 21676154.
    c. Eyler RF, Heung M, Pleva M, Sowinski KM, Park PK, Napolitano LM, Mueller BA. Pharmacokinetics of oseltamivir and oseltamivir carboxylate in critically ill patients receiving continuous venovenous hemodialysis and/or extracorporeal membrane oxygenation. Pharmacotherapy 2012; 32(12):1061-9. PMID: 23208833.
    d. Eyler RF, Vilay AM, Nader AM, Heung M, Pleva M, Sowinski KM, Depestel DD, Sorgel F, Kinzig M, Mueller BA. Pharmacokinetics of ertapenem in critically ill patients receiving continuous venovenous hemodialysis or hemodiafiltration. Antimicrobial Agents and Chemotherapy 2014;58(3):1320-6. PMID: 24323468. PMCID: PMC3957850.

**Link to published work: https://www.ncbi.nlm.nih.gov/sites/myncbi/1F7kiZJE-uaQb/bibliography/51871212/public/?sort=date&direction=descending**