

Cardio-nephrology Services around the United States: Experience of Three Centers of Excellence

The population of patients with or at risk for concomitant kidney and heart disease is large, continues to grow, and has poor clinical outcomes. The interaction of kidney and heart disease leads to unique pathophysiology, disease manifestations, and treatment, necessitating specialized care that may not be addressed adequately by either cardiology or nephrology alone. The creation of a cardiorenal service at several centers has led to providing excellent clinical service, advanced fellowship education, and grounds for research (Table 1). In this article, we invited leaders from a few of the US centers' cardiorenal (or nephrocardiology) services to take us through their journey into the creation and advancement of this process.

The Columbia University Irving Medical Center Nephrocardiology Experience

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Dr. Stevens reports being a consultant with Health Advances (for hyperoxaluria; 2021), receiving honoraria from the National Institutes of Health/ASN Kidney Innovation Accelerator (KidneyX) COVID-19 Innovation Prize (for Kidney Replacement Therapy Dashboards; 2021), and having a patent on an aptamer-based creatinine sensor that is owned and licensed by Columbia University (ongoing).

The Columbia University Irving Medical Center is a 738-adult inpatient bed tertiary care hospital in the Washington Heights neighborhood of New York City (1). One floor of the hospital is geographically dedicated to cardiology and cardiothoracic surgical patients, representing nearly 22% of all hospital beds (102 cardiology beds and 59 cardiac intensive care unit [ICU] beds in total of which 28 are cardiology care unit beds and 31 are cardiothoracic surgical ICU beds). There are four dedicated cardiothoracic surgical operating rooms and >1000 cardiothoracic surgeries, requiring cardiopulmonary bypass, performed annually.

The high burden of cardiovascular disease in patients with chronic kidney disease and end stage kidney disease (ESKD) and the high incidence of peri-procedural acute kidney injury (AKI) result in a high volume of patients who are admitted to our cardiac services requiring nephrology consultation. Given our high total nephrology consult census (typically 100–130 patients total for all services) and a high percentage of consults coming from the cardiac floor,

a dedicated nephrocardiology consult team was formed in 2007–2008 (in addition to our ESKD, general floor, ICU, and transplant consult teams). In a typical calendar year, this consult team receives 450–500 consults, and our daily service census typically ranges between 15 and 20 patients (approximately 10%–15% of the cardiac floor), with the majority coming from the four ICUs on this floor.

There are several benefits to having a dedicated nephrocardiology consult service (Table 1). First, we provide continuity for both patients and teams by having a dedicated geographical team, and often, we are the only providers in the hospital who have followed a patient from their pre-procedure course in the cardiac care unit, post-operatively in the cardiothoracic ICU (CTICU), and then later as they are transferred out of the ICU to the cardiac floor. This team facilitates peri-operative renal replacement therapy planning (2, 3). Additionally, with a dedicated subgroup—approximately 12 of our 31 nephrology attendings staffing this service—we develop an expertise for the unique challenges of these cardiac patients (e.g., advanced heart failure requiring mechanical support, diuretic refractory cardiorenal syndrome, performing intermittent hemodialysis on patients with a left ventricular assist device without a pulse pressure, or performing continuous renal replacement therapy while on extracorporeal membrane oxygenation). Additionally, given the smaller subset of our attendings who rotate on this service, we develop relationships with the cardiac primary teams that foster collaboration and build trust that extends beyond the patient floors. This results in clinical research collaborations (4–7) and the formation of the multidisciplinary Hypertension Center. Finally, having a dedicated high-volume nephrocardiology consult service provides a unique learning opportunity for our seven general nephrology fellows, two transplant fellows, and one glomerular fellow. They quickly learn the fundamental principles involved in caring for patients with heart disease who are critically ill (from the nuances of volume status exams to diuretic refractory cardiorenal syndrome, severe peri-operative AKI, and refractory hyponatremia).

The Northwell Health Cardiorenal Service Experience

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Dr. Uppal reports no conflicts of interest.

North Shore University Hospital at Northwell Health in Manhasset, NY, is a 786-adult inpatient bed quaternary care primary teaching hospital for the Zucker School of Medicine at Hofstra/Northwell training medical students, residents, nephrology and cardiology fellows, including interventional cardiology, advanced heart failure, and transplant cardiology fellows. It offers all medical and surgical specialties, with recent advancement in heart and lung transplantation. Here, we established the cardiorenal service in 2014 as a distinct inpatient clinical service that comprises a group of seven nephrologists from our faculty who work in close association with cardiologists, cardiothoracic surgeons, and cardiac intensivists.

The inpatient cardiorenal service at North Shore University Hospital is run by the nephrology attending and a fellow in training. It serves to take consultations from regular medical floors, telemetry units, and cardiac and CTICUs. There is a dedicated phone number that is transferred to the attending rotating on the service for weekdays, weeknights, and weekends, which ensures the ease in reaching out to the attending directly and warrants 24/7 availability of the service. The consultants carry a portable point-of-care ultrasound (POCUS) device that aids as a bedside tool for volume assessment during rounds.

Over the past 8 years, the service has expanded tremendously. During the initial years

of the service, the majority of consultations were for optimization of kidney function in patients undergoing percutaneous coronary interventions and management of patients with acute cardiorenal syndrome, including diuretic augmentation and use of renal replacement therapies for volume management. In recent years, our center's cardiology and cardiac surgery programs have expanded, leading to growth in the census of the service as well as additional consultations to manage AKI after procedures, including transcatheter aortic valve replacement, open heart valvular surgeries, VADs, and mechanical circulatory assist devices. Lately, the service also manages kidney issues and electrolyte abnormalities that develop in the peri-operative period for patients receiving heart transplantation, lung transplantation, as well as multiple organ transplantation, such as simultaneous heart, lung, and kidney transplantation. Kidney transplant recipients are followed by the kidney transplant team after the transplantation.

The creation of inpatient service eventually led to development of an outpatient cardiorenal specialist service that consists of eight nephrologists who specifically manage patients with coexisting heart and kidney diseases. These nephrologists receive direct consultations, and the secretarial staff at the office has a list of the dedicated attendings to whom they assign cardiorenal patients for evaluation and management. The office also has a dedicated exam room with a POCUS machine.

The cardiorenal service has been advantageous for patients, consultant specialists, as well as nephrology and cardiology trainees (8). The co-management of patients by a specific group of nephrologists and cardiologists builds a strong relationship among patients and physicians, ensuring regular follow-ups and better patient care. When hospitalized, the patients are under the care of the same group of physicians who communicate well with each other. This prevents polypharmacy and incorrect medication dosing and promotes shared medical decision-making, leading to better patient health.

This service has established an association and trust among the nephrology and cardiol-

ogy specialists that foster an ease to consult each other and advocate persistent communication between each other. It has led to collaboration among nephrologists, cardiologists, medical specialists, and renal pathologists and has enhanced the educational experience for trainees. The fellows, along with the attendings, participate in multidisciplinary team discussions and integrated journal clubs and grand rounds (usually held every 3–4 months by faculty and fellows of either advanced heart failure or nephrology), which keep them up to date with advances in cardiorenal medicine and promote unceasing learning. The

service creates opportunities for future research and organization of conferences, further culminating in combined publications. Several nephrologists from the group have gained recognition at national societies, are national experts in the field of POCUS, and have presented at national cardiology conferences. The nephrologists have attained an expertise in management of kidney manifestations that arise after various cardiac procedures. This has led to an increase in interest among trainees to pursue their careers in this growing field of cardiorenal medicine.

The University of Washington Kidney-Heart Service Experience

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Dr. Bansal reports being an associate editor for Kidney360.

The University of Washington (UW) launched the Kidney-Heart Service in August 2020 (9). The UW Medical Center (UWMC) is a large, 630-bed academic medical center in Seattle, WA, that serves as a catchment area for people in a five-state region (Washington, Wyoming, Alaska, Montana, and Idaho) and is the primary site for the most complex and intensive cardiology care, including heart transplantation, cardiac device implantation, and cardiothoracic surgery. The UW Kidney-Heart Service functions as a specialized, inpatient consultation service and is staffed by three nephrologists who have a specialized clinical and scientific expertise in cardiorenal disease. In designing this new service, our mission was to excel in clinical care, education, and scholarship (Table 1).

The service has focused on nephrology consultation to patients admitted to cardiology or cardiothoracic services on the floors or the ICUs. The average daily census varies between 10 and 20 patients. Since our inception, we have launched several key clinical initiatives. We have developed effective and streamlined communication strategies between the UW Kidney-Heart Service and Cardiology/Cardiothoracic Surgery Inpatient Services. All attendings on the UW Kidney-Heart Service have trained in POCUS and have incorporated this practice into routine clinical decision-making. In collaboration with our cardiology colleagues, we also have revised, updated, and promoted wider use of their evidence-based diuretic algorithm,

which was developed to improve diuretic efficacy, reduce rates of diuretic resistance, decrease the risk of AKI and need for dialysis, and reduce length of stay. This updated algorithm focuses on a “sequential nephron blockade” and use of objective measures to guide diuresis.

Although early, the initial results of these clinical initiatives are promising. Prior to the launch of the Kidney-Heart Service, patients admitted to UWMC with heart failure who developed AKI had three times longer lengths of stay, a three to four higher rate of in-hospital death, and significantly higher rates of readmission within 30 days as compared with patients with heart failure without AKI (9). Since the launch of the UW Kidney-Heart Service, we have observed a 3-day reduction in average length of stay in patients with heart failure and AKI as well as a modest decline in rates of inpatient acute dialysis following launch of the UW Kidney-Heart Service (9).

To fulfill our educational mission, we developed a specialized curriculum that includes core topics such as: volume and hemodynamic assessment, physiology of diuretic resistance, diuretic pharmacokinetics and management, cardiorenal physiology, kidney diseases in patients with durable and non-durable mechanical circulatory support, electrolyte disorders, and acid-base disorders. Nephrology fellows, cardiology fellows, internal medicine residents, and advanced practice provider students rotate on the service, allowing for cross-disciplinary training. We have made several strides to advance quality improvement and research in cardiorenal diseases. We continue to collect longitudinal electronic medical record data on patients seen by the Kidney-Heart Service, which forms the basis for several ongoing quality improvement projects. Patients seen by the service are recruited directly into several research studies. For example, we have received funding for a National Institutes of Health (NIH) R01 grant, “Kidney Injury in Patients with Acute Decompensated Heart Failure,” as well as an NIH administrative supplement to study bioethical issues in patients admitted with acute decompensated heart failure and AKI (9).

In summary, the UW Kidney-Heart Service is an innovative model to advance clinical care, education, and scholarship in cardiorenal disease. ■

Table 1. Advantages of a cardio-nephrology service

Advantages of a dedicated cardio-nephrology service	Examples
Clinical expertise	<ul style="list-style-type: none"> • Volume assessment including POCUS • Peri-operative risk stratification and management for cardiac procedures and surgeries • Diuretic resistance, including sequential nephron blockage and novel therapies • Management of kidney diseases in relation to advanced heart failure therapies, including ventricular assist devices • AKI and dialysis management in cardiogenic shock • Electrolyte disorders in patients with cardiorenal disease • Goal-directed medical therapy (including SGLT2i and MRAs) in patients with cardiorenal disease • Pre-peri and post-heart transplant management
Education	<ul style="list-style-type: none"> • Focused learning on high-yield topics in cardiorenal disease from experts • Opportunities for cardiology and nephrology fellows to work together directly
Scholarship	<ul style="list-style-type: none"> • Recruitment of patients directly into studies, including clinical trials • Opportunities for quality improvement
Other	<ul style="list-style-type: none"> • Promotes collaboration • Enhances nephrology-cardiology communication • Continuity of care (including inpatient-outpatient)

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