

Performance of Procedures by Nephrologists and Nephrology Fellows at U.S. Nephrology Training Programs

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Background and objectives: Some procedures (e.g., placement of temporary hemodialysis catheters and kidney biopsies) are required in nephrology fellowship training. Others (e.g., placement of tunneled hemodialysis catheters, ultrasonography, and hemodialysis access interventions) are not required but are performed at some centers. To assess the procedures performed by nephrologists and nephrology fellows at U.S. adult nephrology training programs and the number of procedures required for fellow competency, a survey was conducted of all such training programs.

Design, setting, participants, & measurements: An on-line survey was e-mailed to the directors of all U.S. adult nephrology fellowship programs in October to November 2007.

Results: Responses were received from 93 of 136 programs. Nephrologists and nephrology trainees perform native and transplant kidney biopsies in 98% to 99% of programs and, in about half of programs, also perform the ultrasound guidance. Diagnostic ultrasounds are performed at fewer programs. Temporary dialysis catheters are inserted at nearly all programs. Tunneled hemodialysis catheters and peritoneal dialysis catheters are placed at $\leq 20\%$ of programs. Interventional procedures on hemodialysis access are performed at 13% to 21% of programs. Continuous renal replacement therapy is performed at 99% of programs, plasmapheresis at 40%. Many programs either do not specify a minimum number of supervised procedures that need to be performed to demonstrate competence or require a very limited number.

Conclusions: Core procedures are performed at almost all programs. Experience and training in other procedures are variable. Many programs have limited requirements for the number of procedures trainees need to perform to demonstrate competence.

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Care of patients with kidney disease involves a number of imaging and invasive procedures. “Core” procedures, such as percutaneous renal biopsy and insertion of temporary hemodialysis catheters, have traditionally been performed by nephrologists but increasingly are performed by other specialists. The involvement of nephrologists in other procedures, such as diagnostic ultrasound, placement of tunneled hemodialysis and peritoneal dialysis catheters, creation of arteriovenous fistulas, and interventions on hemodialysis grafts and fistulas, is limited but may be changing. The number of nephrologists performing dialysis access procedures (interventional nephrologists) in this country is growing, and diagnostic ultrasonography, which is routinely practiced by nephrologists in several European countries, is also becoming more commonplace among nephrologists in the United States. Studies have documented the competence of nephrologists in

performing these procedures and the improvements in patient care that result (1–4).

The continued performance of “core” procedures by future nephrologists as well as the introduction of additional procedures into nephrology requires that these skills be obtained in nephrology training programs. However, procedures are often not a major focus in most programs, and many faculty may feel ill qualified to teach them. To assess what types of procedures are performed by nephrology fellows and faculty at U.S. adult nephrology training programs, an electronic survey was conducted of all such programs. The results of that survey, reported here, demonstrate tremendous variability between programs in the performance of procedures by nephrologists, trainee involvement in the procedures, and criteria for assessing the competence of trainees.

Materials and Methods

An internet-based survey was sent to the directors of all U.S. adult nephrology training programs in October 2007; a follow-up query was sent again in November 2007. The survey listed 19 procedures and asked the same set of questions for each. The questions are listed in Table 1. The survey was written jointly by the authors based on their experience in clinical nephrology, performance and assessment of skills in nephrology-related procedures, and training of renal fellows. The survey was e-mailed to training program directors by staff of the American Society of Nephrology. Responses to the survey were entered

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Table 1. Questions asked for each procedure in the survey

1. Is this procedure [list of procedures is below] currently performed by Nephrology Division faculty or fellows at your institution?
2. If yes, in what percentage of your program's patients [<25%, 25%-50%, >50%-75%, >75%-100%] is this procedure performed by first or second year Nephrology fellows with Nephrology faculty supervision?
3. If yes, what minimum number of such procedures performed by first or second year Nephrology fellows is required to be performed to document expected competence? Leave blank if procedure not done at your institution, enter 0 (zero) if done but no established minimum number for competence.
4. If yes, in what percentage of your program's patients [<25%, 25%-50%, >50%-75%, >75%-100%] is this procedure being performed by Nephrology faculty without fellows?
5. If no, who performs each procedure at your institution?
6. If not currently performed on a regular basis by Nephrology faculty or fellows, do you anticipate beginning this procedure as part of your program in the near future (*i.e.*, within one year)?

Procedures included in survey

Temporary HD catheters: IJ vein
 Temporary HD catheters: femoral vein
 Tunneled dialysis catheters: inpatient
 Tunneled dialysis catheters: outpatient
 Peritoneal catheter
 Percutaneous native kidney biopsy
 Percutaneous transplant kidney biopsy
 Ultrasound guidance for native kidney biopsy (without a radiologist)
 Ultrasound guidance for transplant kidney biopsy (without a radiologist)
 Diagnostic native kidney ultrasound (without a radiologist)
 Diagnostic transplant kidney biopsy (without a radiologist)
 Plasmapheresis
 Thrombectomy of dialysis access: inpatient
 Thrombectomy of dialysis access: outpatient
 Angioplasty of dialysis access: inpatient
 Angioplasty of dialysis access: outpatient
 Stenting of dialysis access: inpatient
 Stenting of dialysis access: outpatient
 Continuous renal replacement therapy

HD, hemodialysis; IJ, internal jugular.

by the respondents directly into an internet-based database and were anonymous; only one response per training program was permitted. No information about responding training programs was collected. American Society of Nephrology staff tabulated responses.

Results

Of 136 adult nephrology programs contacted, 84 (62%) responded to the initial e-mail sent to training program directors in October 2007 and 9 additional programs responded to a follow-up e-mail in November 2007, with 93 programs (68%) responding overall. Response counts varied from 91 to 93 for each item in question 1. Table 2 shows the number and percent of programs that currently perform each procedure (responses to question 1) and plan to begin performing procedures that are not currently done by nephrology faculty and trainees (responses to question 6). Table 3 shows the estimated percent of patients at each program who have specified procedures performed by first- or second-yr nephrology fellows (with faculty supervision; responses to question 2).

Femoral vein dialysis catheters are inserted by fellows in all

but two programs, and internal jugular (IJ) vein catheters are inserted at 79% of programs. Fellows place more than 50% of the temporary hemodialysis catheters at approximately two thirds of programs, but at a smaller number of programs they insert fewer than 25% of these catheters. In a minority of programs, nephrology fellows insert tunneled hemodialysis catheters and peritoneal dialysis catheters, and another 5% to 10% of programs anticipate doing so in the next year. At most programs, only a minority of these catheters are placed by nephrology fellows.

Percutaneous biopsy of native and transplanted kidneys is performed by nephrology fellows in almost all programs, with fellows performing >50% of biopsies at the vast majority of programs. The two programs not currently performing native kidney biopsies reported plans to do so within one year, as did two of four programs not currently performing transplant biopsies. In about half the programs, nephrologists and trainees are performing ultrasound guidance for the biopsy without a radiologist, and several programs plan to begin doing this

Table 2. Responding programs indicating that procedures are currently performed by nephrology fellows and faculty or planned within the next year (responses to questions 1 and 6)

Procedure	Currently ^a	Planned ^b
Temporary HD catheter: IJ vein	73 (79)	1 (1)
Temporary HD catheter: femoral vein	91 (98)	0
Tunneled HD catheter: inpatient	13 (14)	7 (8)
Tunneled HD catheter: outpatient	19 (20)	9 (10)
Peritoneal dialysis catheter	13 (14)	5 (5)
Percutaneous native kidney biopsy	91 (99)	2 (2)
Percutaneous transplant kidney biopsy	90 (98)	2 (2)
US guidance: native kidney biopsy ^c	39 (42)	7 (8)
US guidance: transplant kidney biopsy ^c	46 (51)	7 (8)
Diagnostic native kidney US ^c	7 (8)	8 (9)
Diagnostic transplant kidney US ^c	10 (11)	7 (8)
Plasmapheresis	37 (40)	3 (3)
Thrombectomy of HD access: inpatient	13 (14)	6 (7)
Thrombectomy of HD access: outpatient	19 (21)	9 (10)
Angioplasty of HD access: inpatient	12 (13)	6 (7)
Angioplasty of HD access: outpatient	18 (19)	9 (10)
Stenting of HD access: inpatient	12 (13)	4 (4)
Stenting of HD access: outpatient	15 (16)	6 (7)
Continuous renal replacement therapy	92 (99)	2 (2)

HD, hemodialysis; IJ, internal jugular; US, ultrasound.

^aValues are no. (%) of all responding programs at which procedure is performed.

^bValues are no. (%) of programs at which procedure is not currently being performed (answered "no" to question 1) but is planned in the near future (answered "yes" to question 6). If no response to question 6, counted as a "no" response.

^cWithout a radiologist.

Table 3. Percent of program's patients in who procedure is performed by first or second year nephrology fellows with faculty supervision (responses to question 2)

Procedure	<25%	25–50%	>50–75%	>75–100%
Temporary HD catheter: IJ vein	25	11	25	40
Temporary HD catheter: femoral vein	17	15	23	46
Tunneled HD catheter: inpatient	57	10	14	19
Tunneled HD catheter: outpatient	64	5	14	18
Peritoneal dialysis catheter	59	12	18	12
Percutaneous native kidney biopsy	5	0	13	82
Percutaneous transplant kidney biopsy	7	2	21	70
US guidance: native kidney biopsy ^a	19	2	21	57
US guidance: transplant kidney biopsy ^a	21	0	25	55
Diagnostic native kidney US ^a	67	7	0	27
Diagnostic transplant kidney US ^a	61	17	0	22
Plasmapheresis	34	5	5	56
Thrombectomy of HD access: inpatient	65	5	10	20
Thrombectomy of HD access: outpatient	64	14	9	14
Angioplasty of HD access: inpatient	68	11	0	21
Angioplasty of HD access: outpatient	64	18	0	18
Stenting of HD access: inpatient	68	11	0	21
Stenting of HD access: outpatient	67	14	0	19
Continuous renal replacement therapy	4	2	10	85

HD, hemodialysis; IJ, internal jugular; US, ultrasound. Total percentages in each row may exceed 100% due to rounding.

^aWithout a radiologist.

within the next year. Diagnostic sonograms of native and transplant kidneys are performed by nephrologists and trainees at relatively few programs, and at most of these, they perform only a minority of the studies. Of the programs not performing diagnostic native or transplant renal ultrasonography, 13% and 11%, respectively, anticipate adding these procedures within the next year.

Interventional procedures on hemodialysis accesses are performed by nephrologists and nephrology trainees at as many as 21% of programs, depending on the procedure and patient location, with several additional programs planning to begin doing so in the next year. The programs reporting that they did outpatient procedures include all of those performing inpatient procedures. At most programs, only a minority of these procedures are performed by the nephrology service.

Continuous renal replacement therapy is performed by nephrology fellows at 98% of programs and is planned at the remaining two programs in the next year. Plasmapheresis is performed by nephrology fellows at 40% of programs, with few programs planning to add plasmapheresis in the next year. At most programs, plasmapheresis is managed by hematologists, pathologists, or a dedicated pheresis service.

Nephrology faculty perform few core procedures without fellows. In >90% of programs, procedures, such as placement of temporary hemodialysis catheters, native kidney biopsies, and continuous renal replacement therapy, are performed by faculty alone in <25% of cases. Conversely, ≥50% of the peritoneal dialysis catheters and tunneled hemodialysis catheters were reported to be done by faculty alone at 21% (inpatient tunneled hemodialysis catheters), 25% (outpatient tunneled hemodialysis catheters), and 24% (for peritoneal dialysis catheters) of programs, and ≥50% of hemodialysis arteriovenous access interventions were done by faculty alone at 39% (for inpatient procedures) and 48% (for outpatient procedures) of programs.

Programs were also asked to indicate the minimum number of procedures required of their trainees to establish competence. As shown in Figures 1 and 2, this varied considerably

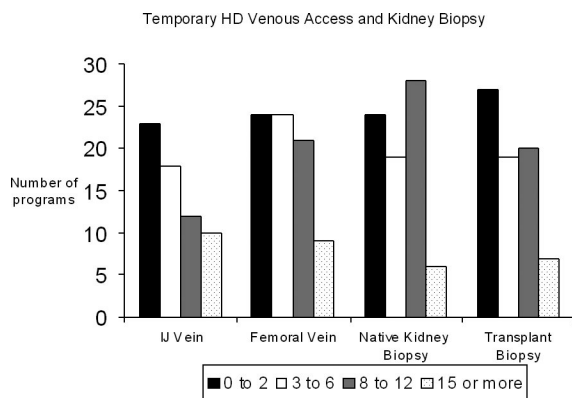


Figure 1. Number of programs reporting specific minimum numbers of procedures required for documentation of competence in insertion of temporary hemodialysis catheters and performance of kidney biopsies.

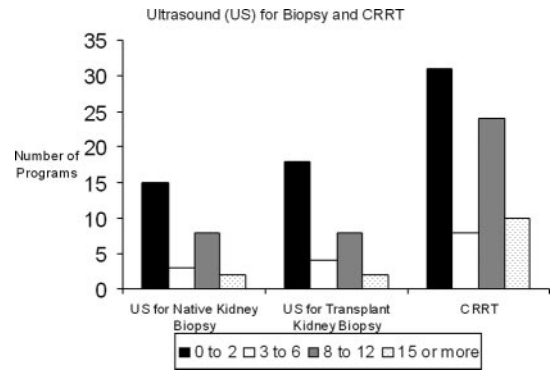


Figure 2. Number of programs reporting specific minimum numbers of procedures required for documentation of procedural competence in ultrasound for kidney biopsies and continuous renal replacement therapy (CRRT).

among programs for most procedures. Many programs reported no specific minimum requirements (Table 4), including the “core” procedures of renal biopsy and insertion of temporary hemodialysis catheters.

Discussion

This is the first survey of procedures performed within adult (Internal Medicine) nephrology training programs in the

Table 4. Programs performing procedure with no minimum number required for documentation of expected competence (responses of 0 to question 3)

Procedure	No Requirement ^a
Temporary HD catheter: IJ vein	29 (41)
Temporary HD catheter: femoral vein	28 (32)
Tunneled HD catheter: inpatient	10 (67)
Tunneled HD catheter: outpatient	9 (60)
Placement of peritoneal dialysis catheter	9 (60)
Percutaneous native kidney biopsy	28 (33)
Percutaneous transplant kidney biopsy	30 (36)
US guidance: native kidney biopsy ^b	18 (58)
US guidance: transplant kidney biopsy ^b	21 (60)
Diagnostic native kidney US ^b	6 (60)
Diagnostic transplant kidney US ^b	8 (62)
Plasmapheresis	22 (59)
Thrombectomy of HD access-inpatient/ outpatient	7 (64)/7 (54)
Angioplasty of HD access-inpatient/ outpatient	7 (70)/7 (54)
Stenting of HD access-inpatient/ outpatient	7 (70)/8 (62)
Continuous renal replacement therapy	34 (40)

HD, hemodialysis; IJ, internal jugular; US, ultrasound.
^aNo. (%) of programs reporting no minimum number of procedures (not all programs responded to each item).
^bWithout a radiologist.

United States since one reported in 1992 (5). This earlier survey of 60 program directors focused mostly on time devoted during fellowship to various educational components of training but did report that fellows inserted a median of 55 femoral dialysis catheters (range, 5 to 720) and 2 acute peritoneal dialysis catheters (range, 0 to 300) during training, with limited but highly variable experience with chronic peritoneal dialysis catheter placement, continuous arteriovenous dialysis, and bone biopsy. With an overall response rate of 68%, our survey represents the majority of U.S. adult nephrology training programs and provides the most current and detailed assessment of training of renal fellows in performance of nephrology-related procedures. The results have important implications for nephrology and nephrology education in terms of the training offered in various procedures, requirements for this training, and assessment of proficiency of trainees.

Although “core” procedures, such as percutaneous renal biopsy, insertion of temporary hemodialysis catheters, and continuous renal replacement therapy, are performed at almost all of the programs that responded, experience and training are limited in a number of them. Almost one fourth of programs do not offer training in insertion of IJ vein catheters. The reason for this is unclear because the procedure is no more technically challenging than femoral vein insertion and the risks, when performed with ultrasound guidance, are not higher than with femoral vein catheters (6). Assuming that nephrologists and trainees at programs that do not insert femoral vein catheters also do not insert IJ vein catheters, this indicates that some nephrology training programs in this country offer no experience in the insertion of temporary hemodialysis catheters. Insertion of tunneled hemodialysis catheters is even less frequently performed by nephrology fellows. This may reflect the fact that the procedure is more practical when performed with sedation in a dedicated procedure suite that may not be available to nephrologists and nephrology trainees.

The advent of interventional nephrology has changed the role of nephrologists in procedures related to hemodialysis at some programs, with increasing numbers of nephrologists and trainees placing tunneled hemodialysis catheters, performing interventions on arteriovenous grafts and fistulas, and, to a lesser extent, placing peritoneal dialysis catheters. It is likely that the opportunity to develop and maintain skills necessary to place peritoneal dialysis catheters is hindered by the limited experience in managing patients on peritoneal dialysis at many programs (7). Because insertion of these catheters is a simple and safe procedure that can readily be performed by nephrologists, incorporation of this procedure into training programs may serve to stimulate increased use of peritoneal dialysis (8–11).

Perhaps related to the availability of relatively inexpensive office-based and portable equipment, ultrasonography is being used by an increasing number of clinical specialists. Despite the importance of ultrasonography in the practice of nephrology, this survey indicates that incorporation of training in diagnostic ultrasound into nephrology training programs is limited. However, in approximately half of programs, nephrologists are performing ultrasound guidance for renal biopsies. This, to-

gether with the fact a number of programs plan to incorporate diagnostic ultrasonography in the near future, suggests that there is increasing interest in making renal ultrasound an integral part of nephrology practice and training.

Although not addressed in this survey, there are several reasons that might explain why nephrology programs do not offer training in certain procedures. These include lack of skilled faculty, the need for special facilities and initial capital outlays, “turf” battles, a focus on research as opposed to clinical care and training, and the fact that it is not required for accreditation. In addition, faculty may feel ill qualified to teach and supervise procedures, and the time required is often perceived to be poorly spent. These obstacles can usually be overcome, as demonstrated by the programs that have been successful in offering this training (1,4). It is also likely that fellows and applicants to fellowship programs will increasingly expect training in these procedures.

Imperative in training is some assessment of proficiency which, for procedures, usually consists of a minimum number of procedures performed and some assessment of competence by the trainer. Although there is also a knowledge base that can be assessed by standardized testing, practical “hands-on” experience with these procedures is essential. Several medical subspecialty societies have published guidelines that specify a minimum number of procedures that are required for demonstration of competence or that must be performed before competence can be assessed, including cardiovascular medicine, gastroenterology, and pulmonary medicine (12–17). Guidelines for a number of nephrology procedures have been established by the American Society of Diagnostic and Interventional Nephrology (ASDIN) (18–20), but these have not been endorsed by other nephrology organizations or broadly implemented in training programs. The required number of studies (as primary operator) for ASDIN certification in catheter insertion are as follows: temporary hemodialysis catheters, 25; tunneled hemodialysis catheters, 10 in addition to the requirement for temporary catheters; and peritoneal catheters, 6. The mean required number of catheter insertions in the training programs responding to this survey is thus consistent with these guidelines (based on combining the numbers for IJ and femoral veins). For angioplasty, thrombolysis, and stenting, the ASDIN requires 10, 10, and 5 procedures, respectively. If the numbers reported in our survey represent total procedures, then many programs have substantially lower requirements than ASDIN. Because the extent to which practicing nephrologists perform various procedures beyond fellowship training is not known, it is not clear that meeting the ASDIN requirements is essential for all trainees.

Position papers recommending minimal training necessary for competence in percutaneous renal biopsy, acute hemodialysis, and acute peritoneal dialysis were published by the American College of Physicians 20 yr ago (21–23), noting specific cognitive and technical skills needed but not how technical competence should be determined or a specific number of procedures that should be performed during training. In a survey of practicing nephrologists conducted more than 20 yr ago, respondents offered recommendations for the minimum

number of procedures needed to achieve and maintain competence (24); for renal biopsy and acute hemodialysis between 7 to 20 (25th to 75th percentile) and 10 to 50, respectively, were recommended. Similar numbers (6 to 15 for renal biopsy and 10 to 20 for acute hemodialysis) were also recommended in an unpublished survey of training program directors cited in this report (24).

Our survey indicates a wide variation among programs in the required number of procedures performed by trainees. Variability in training experience for procedures in other medical subspecialties has also been reported (25,26). The variability in training among nephrology training programs likely reflects, at least in part, the lack of specific requirements from the Accreditation Council for Graduate Medical Education (ACGME). Although ACGME stipulates training in urinalysis, acute and chronic hemodialysis, peritoneal dialysis, continuous renal replacement therapy, placement of vascular catheters for hemodialysis, and performance of native and transplant kidney biopsies, no minimum number of procedures per trainee is specified, and there are no defined criteria for determining competence. The guidelines also do not specify whether training in temporary hemodialysis catheters must include IJ catheters. Ultrasonography, insertion of tunneled peritoneal or hemodialysis catheters, and procedures on hemodialysis grafts and fistulae are not included in current ACGME requirements.

A lack of adequate training in procedural skills has important implications for the practice of nephrology. In particular, it limits the scope of care provided by nephrologists, leading to fragmented and less timely patient care. As fewer nephrologists perform these procedures, fewer trainees learn them, compounding the problem. This also affects nephrology as a profession. One of the authors was recently asked by a medical student: “Don’t nephrologists do any procedures?” Reliance on others to perform diagnostic and invasive procedures on our patients may be limiting interest in nephrology as a career. A recent study found that nearly half of first-year medical residents who expressed careers plans for nephrology ultimately chose other subspecialties (27). Although this “drop out” rate was not dissimilar to that for other subspecialties, the initial interest in nephrology was already much less than in other more procedural subspecialties. The effectiveness of renal fellowship training for clinical practice was assessed in a survey of nephrologists who trained in the 1970s and 1980s (28). Training was thought to be ineffective by more than half of respondents for plasmapheresis, subclavian vein catheterization, high efficiency hemodialysis, continuous arteriovenous dialysis, and chronic peritoneal access. We are not aware of any subsequent assessment of the adequacy of fellowship training for performance of procedures.

There are limitations to our findings. The survey was developed and written by the authors without involvement of experts in survey methodology; it was not “field tested” before its general distribution to program directors, and no attempt was made to verify the accuracy of the responses. In this regard, it is similar to other surveys in this field (5,24,28). Participation was voluntary and 32% of program directors did not respond. Because we do not have data identifying specific programs, it is

not possible to determine to what extent the sample is representative of all programs. However, any bias is likely the result of a greater participation by programs that offer more training in procedures. Also, the responses to questions 2 and 4 are undoubtedly estimates and should not be interpreted quantitatively. Lastly, not all procedures were included in the survey, which did not query about performance of urinalysis or bone biopsy.

Conclusion

This survey presents the first comprehensive picture of training in nephrology procedures in the United States. The results indicate that there are opportunities to expand the procedural armamentarium of nephrologists and the procedure-related training of nephrology fellows. Adequate training will require greater emphasis by the training programs reflected in an increased number of trained faculty performing procedures and standardized criteria for assessing competence. It is of some concern that many training programs have not established minimum requirements for training and assessment of procedural competence.

Disclosures

None.

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See related editorial, "Procedures in Nephrology Fellowships: Time for Change," on pages 931–932.