Validity of *International Classification of Diseases, Ninth Revision, Clinical Modification* Codes for Acute Renal Failure

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Administrative and claims databases may be useful for the study of acute renal failure (ARF) and ARF that requires dialysis (ARF-D), but the validity of the corresponding diagnosis and procedure codes is unknown. The performance characteristics of *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) codes for ARF were assessed against serum creatinine–based definitions of ARF in 97,705 adult discharges from three Boston hospitals in 2004. For ARF-D, ICD-9-CM codes were compared with review of medical records in 150 patients with ARF-D and 150 control patients. As compared with a diagnostic standard of a 100% change in serum creatinine, ICD-9-CM codes for ARF had a sensitivity of 35.4%, specificity of 97.7%, positive predictive value of 47.9%, and negative predictive value of 96.1%. As compared with review of medical records, ICD-9-CM codes for ARF-D had positive predictive value of 94.0% and negative predictive value of 90.0%. It is concluded that administrative databases may be a powerful tool for the study of ARF, although the low sensitivity of ARF codes is an important caveat. The excellent performance characteristics of ICD-9-CM codes for ARF-D suggest that administrative data sets may be particularly well suited for research endeavors that involve patients with ARF-D.

The epidemiology of ESRD has been studied extensively using large databases such as the United States Renal Data System and similar registries in Canada, Europe, Australia, and New Zealand (1–4). In contrast, the epidemiology of acute renal failure (ARF) in hospitalized patients is less well understood, having been derived largely from single-center retrospective studies that used detailed review of medical records (5–7). Few investigations in ARF have taken advantage of the wealth of administrative data that are available in hospital discharge and claims databases.

We undertook this study to evaluate the accuracy of administrative codes for ARF for applications in clinical epidemiology and health services research. Validation of these codes is a prerequisite to the use of administrative data for the study of ARF. We compared *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) (8) codes from hospital discharge records

against serum creatinine–based definitions of ARF. In addition, we reviewed medical records to establish the accuracy of coding for ARF that requires dialysis (ARF-D).

Materials and Methods

Description of Participating Hospitals

We analyzed linked administrative and laboratory data from individuals who were admitted to three academic teaching hospitals in Boston, MA. Brigham and Women's Hospital (BWH) is a 720-bed urban tertiary care teaching hospital that is affiliated with Harvard Medical School, a large health maintenance organization (Harvard Pilgrim Health Care), Dana Farber Cancer Institute, a community hospital (Faulkner Hospital), and several community-based health centers. Massachusetts General Hospital (MGH) is a 900-bed tertiary care teaching hospital that is affiliated with Harvard Medical School and several community-based health centers. Caritas-St. Elizabeth's Medical Center (CSEMC) is a 400-bed community-based tertiary care center that is affiliated with Tufts University School of Medicine. Combined, the three hospitals provide care to an ethnically and socioeconomically diverse population within eastern Massachusetts and the surrounding region.

Database Structure

Data on all discharges from BWH and MGH during 2004 were obtained through the Research Patient Data Registry, a registry that is

maintained by Partners Healthcare System, which is the administrative body that oversees operations at BWH and MGH. The Research Patient Data Registry serves as a central clinical data warehouse for >1.8 million inpatients and outpatients; the database contains information on patient demographics, diagnoses and procedures, medications, inpatient and outpatient encounters, health care providers, and laboratory results. The database was designed for research and quality improvement purposes and has been accessed previously for clinical studies (5,9). Data on all discharges from CSEMC during 2004 were obtained specifically for this project by linking laboratory and hospital administrative databases.

For each discharge, the following data were available: Patient demographics, patient disposition, admitting service, ICD-9-CM codes for up to 15 diagnoses and procedures, and serum creatinine values at various points (admission, discharge, highest value during hospitalization [peak], and lowest value during hospitalization [nadir]). To assess temporal trends in coding practices, we also analyzed data from MGH in 1994 and 1998 and from CSEMC in 2000 and 2002. All adults (age ≥18 yr) who required hospitalization were included in the analytic data set. Use of these databases for research was approved by the appropriate Institutional Review Boards.

ICD-9-CM Codes for ARF, ARF-D, and Renal Replacement Therapies

We identified patients with administrative codes for ARF by the presence of ICD-9-CM codes 584.5, 584.6, 584.7, 584.8, or 584.9 in any of the listed diagnoses. Of these, the most frequent codes were 584.5 (ARF with lesion of tubular necrosis; 13.3%) and 584.9 (ARF, unspecified; 86.2%). ARF-D was identified by the additional presence of any of the following ICD-9-CM codes for hemodialysis: Procedure code 39.95 (hemodialysis) or diagnosis codes V45.1 (renal dialysis status), V56.0 (extracorporeal dialysis), or V56.1 (fitting and adjustment of dialysis catheter). The procedure code 39.95 accounted for 98.4% of all hemodialysis codes in patients with ARF-D.

Maintenance hemodialysis and peritoneal dialysis were defined by the presence of a dialysis code (procedure codes 39.95 or 54.98 and/or diagnosis codes V45.1 or V56.x) without an ARF (584.x) diagnosis code. We identified patients who were undergoing kidney transplantation by the presence of the procedure code 55.69. Detailed descriptions of the ICD-9-CM codes that we used are available in the Appendix.

Diagnostic Standards for ARF and ARF-D

We compared administrative codes for ARF against standard definitions of ARF on the basis of serum creatinine results during hospitalization. We used two standard definitions using nadir and peak values of serum creatinine: (1) A 100% change and (2) a variable change depending on the nadir serum creatinine (change of 0.5, 1.0, and 1.5 mg/dl for nadir serum creatinine ≤1.9, 2.0 to 4.9, and ≥5.0 mg/dl, respectively) as described by Hou and colleagues (6,7). To capture community-acquired ARF, in which the peak serum creatinine may precede the nadir, neither ARF definition specified the temporal relationship between peak and nadir serum creatinine. Patients with fewer than two serum creatinine measurements were considered not to have ARF by both diagnostic standards. The diagnostic standard for ARF-D was based on review of hospital discharge summaries and/or progress notes to verify the receipt of hemodialysis (either conventional hemodialysis or continuous renal replacement therapy) and to ensure that patients were not receiving maintenance hemodialysis for ESRD.

Diagnostic Performance Characteristics of ICD-9-CM Codes

We calculated the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of ICD-9-CM codes for

ARF against two serum creatinine–based standard definitions of ARF. For these calculations, we excluded patients who were on maintenance hemodialysis or peritoneal dialysis and those who were undergoing kidney transplantation, because fluctuations in serum creatinine among these patients do not reflect the occurrence of ARF.

Because chart review of our entire database was not feasible, we determined the performance characteristics of administrative codes for ARF-D in a subpopulation of 300 discharges in which chart review was performed. At each hospital, we randomly selected 50 discharges of patients with ARF-D on the basis of administrative codes (i.e., ICD-9-CM codes for ARF and hemodialysis, as defined above); this enabled calculation of PPV. We then identified 50 "control" discharges with the highest a priori likelihood of false-positive and false-negative coding for ARF-D; these included 25 randomly selected patients with procedure codes for hemodialysis only, as well as 25 severe cases of ARF (based on the largest change in serum creatinine), where a concomitant hemodialysis code was not present. In this manner, we were able to calculate the NPV. Using these data, we also calculated the sensitivity and the specificity in this subpopulation.

Statistical Analyses

All analyses were performed with SAS version 9.1 (SAS Institute, Cary, NC). Continuous variables were expressed as means with SD and medians with interquartile ranges (IQR) or 10th and 90th percentiles and were compared with the Mann-Whitney U test. We compared the sensitivity of ICD-9-CM diagnostic codes for ARF across subgroups of patients with the χ^2 test. Two-tailed $P < 0.05$ was considered statistically significant.

Results

We compiled data on 99,629 discharges from three teaching hospitals in Boston, MA. The demographic characteristics, admitting services, and lengths of stay of hospitalized patients are shown in Table 1. Altogether, 4.2% of discharges received a code for ARF, and 0.4% received the combined diagnosis and procedure codes for ARF-D (Table 2). More than 65% of patients had two or more serum creatinine measurements recorded. Among 34,337 patients with fewer than two serum creatinine measurements, only 53 received an ICD-9-CM code for ARF.

Among 97,705 patients who did not undergo maintenance hemodialysis, peritoneal dialysis, or kidney transplantation during hospitalization, the median nadir serum creatinine value was 0.8 mg/dl (10th percentile 0.5 mg/dl; 90th percentile 1.5 mg/dl). The median peak serum creatinine value was 1.0 mg/dl (10th percentile 0.7 mg/dl; 90th percentile 2.2 mg/dl). A total of 5.8% developed a 100% change in serum creatinine, and 12.0% had ARF according to the criteria of Hou and colleagues (6,7) (Table 3). The median change (peak value minus nadir value) in serum creatinine during hospitalization for patients with ICD-9-CM codes for ARF was 1.2 mg/dl (IQR 0.7 to 2.1 mg/dl) compared with 0.2 mg/dl (IQR 0.1 to 0.2 mg/dl) for patients without ARF codes ($P < 0.001$). Patients with the ICD-9-CM code 584.5 (ARF with lesion of tubular necrosis) had a larger median change in serum creatinine than those with the ICD-9-CM code 584.9 (ARF, unspecified; 1.9 versus 1.2 mg/dl; $P < 0.001$).

Using the definition of ARF by Hou and colleagues, ICD-9-CM codes for ARF had a sensitivity of 28.3%, specificity of

Table 1. Characteristics of patients hospitalized at three Boston-area teaching hospitals in 2004[a]

	BWH (n = 42,609)	MGH (n = 42,119)	CSEMC (n = 14,901)	Combined (n = 99,629)
Mean age (yr [SD])	53.3 (18.8)	58.4 (19.0)	60.4 (20.8)	56.6 (19.4)
Female (%)	63.3	52.5	56.4	57.7
Race (%)				
white	70.3	83.3	82.8	77.7
black	11.7	4.3	5.2	7.6
other	11.6	10.0	9.1	10.6
missing	6.5	2.3	2.9	4.2
Admitting service (%)				
medicine	38.7	49.0	64.4	46.9
surgery	34.6	37.7	11.2	32.4
obstetrics and gynecology	26.1	11.5	10.9	17.7
other	0.6	1.9	13.5	2.0
Median length of stay (d [10th and 90th percentiles])	3 (1, 10)	4 (1, 13)	3 (1, 10)	3 (1, 11)

[a]BWH, Brigham and Women's Hospital; MGH, Massachusetts General Hospital; CSEMC, Caritas-St. Elizabeth's Medical Center.

Table 2. Discharge diagnoses and procedures according to ICD-9-CM codes at three Boston-area teaching hospitals in 2004[a]

	BWH (n = 42,609)	MGH (n = 42,119)	CSEMC (n = 14,901)	Combined (n = 99,629)
ARF (%)	3.4	5.0	4.2	4.2
ARF-D (%)	0.3	0.5	0.4	0.4
Maintenance hemodialysis (%)	1.7	1.9	1.5	1.7
Maintenance peritoneal dialysis (%)	0.1	0.2	0.0	0.1
Chronic kidney disease (%)	1.0	1.0	0.9	2.0
Kidney transplantation (%)	0.2	0.2	0.0	0.1

[a]ARF, acute renal failure; ARF-D, acute renal failure that requires dialysis; ICD-9-CM, *International Classification of Diseases, Ninth Revision, Clinical Modification*.

Table 3. Incidence of ARF, defined by change in serum creatinine, at three Boston-area teaching hospitals in 2004 (excluding patients on maintenance hemodialysis, maintenance peritoneal dialysis, and those undergoing kidney transplantation)

	BWH (n = 41,800)	MGH (n = 41,228)	CSEMC (n = 14,677)	Combined (n = 97,705)
0.5 mg/dl increase (%)	11.2	14.7	11.9	12.9
50% increase (%)	13.7	18.2	11.5	15.3
100% increase (%)	5.1	7.0	4.3	5.8
Hou criteria[b] (%)	10.5	14.0	11.0	12.0

[b]Change of 0.5, 1.0, and 1.5 mg/dl for nadir serum creatinine ≤1.9, 2.0 to 4.9, and ≥5.0 mg/dl, respectively (6).

99.0%, PPV of 80.2%, and NPV of 91.0%. Using a 100% change in serum creatinine as the diagnostic standard, ICD-9-CM codes for ARF had a sensitivity of 35.4%, specificity of 97.7%, PPV of 47.9%, and NPV of 96.1% (Table 4). When a change in serum creatinine of 0.5 mg/dl was used as the definition of ARF, sensitivity was lower (28.5%) and PPV was higher (86.3%).

We found significant variations in the sensitivity of the ICD-9-CM codes for ARF in identifying patients with a 100% change in serum creatinine during admission. Sensitivity was higher in men than in women (41.1 *versus* 30.0%; $P < 0.001$), in patients who were admitted to medicine *versus* surgery (42.1 *versus* 23.9%; $P < 0.001$), in the elderly (41.4 for patients ≥75 yr *versus*

Table 4. Diagnostic performance characteristics of ICD-9-CM codes for ARF compared against two serum creatinine–based definitions at three Boston-area teaching hospitals in 2004

	BWH (n = 41,800)	MGH (n = 41,228)	CSEMC (n = 14,677)	Combined (n = 97,705)
Hou definition[b] (%)				
sensitivity (%)	26.2	29.3	30.2	28.3
specificity (%)	99.2	98.9	99.0	99.0
PPV (%)	79.9	81.1	77.9	80.2
NPV (%)	92.0	89.6	91.9	91.0
100% change				
sensitivity (%)	32.2	35.1	47.6	35.4
specificity (%)	98.1	97.2	97.7	97.7
PPV (%)	47.4	48.4	47.5	47.9
NPV (%)	96.5	95.2	97.7	96.1

[a]NPV, negative predictive value; PPV, positive predictive value.
[b]Change of 0.5, 1.0, and 1.5 mg/dl for nadir serum creatinine $\leq$1.9, 2.0 to 4.9, and $\geq$5.0 mg/dl, respectively (6).

32.6% for patients <75 yr; $P < 0.001$), and in those who died in-hospital (51.5 for nonsurvivors *versus* 32.8% for those who survived to discharge; $P < 0.001$). We found no statistically significant differences in sensitivity between white and black patients (35.5 *versus* 39.2%; $P = 0.12$).

The sensitivity of ICD-9-CM codes for ARF to identify patients with a 100% change in serum creatinine increased over time. At MGH, sensitivity was 17.8% in 1994, 20.5% in 1998, and 35.1% in 2004. At CSEMC, sensitivity was 26.9% in 2000, 31.7% in 2002, and 47.6% in 2004.

The diagnostic performance characteristics of ICD-9-CM codes for ARF-D were considerably better than for ARF (Table 5). Using medical record review as the diagnostic standard, PPV was 94.0% and NPV was 90.0% for the diagnosis of ARF-D. Within the subpopulation of 300 patients evaluated, sensitivity was 90.4% and specificity was 93.8%.

Discussion

Administrative and claims databases have been used only recently to study ARF (10–12). Previous epidemiologic investigations of ARF largely have been from single centers using medical record review. Hou *et al.* (6) reported an ARF incidence of 5% in >2200 medical and surgical inpatients whose medical records were reviewed. Correlates of ARF included decreased renal perfusion, major surgery, radiocontrast exposure, and aminoglycoside administration. Using the same criteria to iden-

tify patients with ARF, Nash *et al.* (7) updated this report, demonstrating a similar risk factor profile and an ARF incidence of 7%. Chertow *et al.* (5) described varying incidence rates of ARF using multiple definitions, ranging from well below 1% for large changes in serum creatinine, 13% for patients with increases in serum creatinine $\geq$0.5 mg/dl, and >30% when considering smaller but clinically significant changes in serum creatinine. Although informative, these studies do not have the power to examine large populations or to examine trends over time, as is possible with administrative and claims databases.

Advantages of using administrative data for epidemiologic and health services research include the large sample sizes, unparalleled generalizability, and relatively low costs. We validated administrative data locally to guide us in conducting more broad-based research on ARF from nationally representative sources. Whereas administrative coding has been examined for specific disease states (13–19) and comorbidity profiles (20,21), this is the first study to focus on the validation of ARF codes against objective serum creatinine–based definitions of ARF in a large population of hospitalized patients. This also is the first study to investigate ICD-9-CM codes for ARF-D.

ICD-9-CM codes for ARF failed to identify a large fraction of patients with clinically significant changes in serum creatinine during hospitalization. However, ARF codes had high specificity and NPV and moderate PPV. Patients with and without

Table 5. Diagnostic performance characteristics of ICD-9-CM codes for ARF-D at three Boston-area teaching hospitals in 2004

	BWH (n = 100)	MGH (n = 100)	CSEMC (n = 100)	Combined (n = 300)
Sensitivity (%)	94.0	86.7	90.6	90.4
Specificity (%)	94.0	91.5	95.7	93.8
PPV (%)	94.0	92.0	96.0	94.0
NPV (%)	94.0	86.0	90.0	90.0

ARF-D were identified reliably by ICD-9-CM codes for ARF-D with high sensitivity and specificity; the PPV and NPV for ICD-9-CM codes for ARF-D also were high.

The occurrence of ARF in our study (12.0% of hospitalizations) was higher than that found in earlier studies by Nash *et al.* (7.2% in 1996) and Hou *et al.* (4.9% in 1978 to 1979) using the same definition of ARF (6,7); this finding suggests that ARF is an increasingly common complication, perhaps as a result of the increasing age and comorbidity burden of the hospitalized population.

We found that administrative data had low sensitivity for the identification of ARF: Only 35.4% of patients with a 100% change in serum creatinine were given the ICD-9-CM diagnosis code 584.x. Our findings are comparable to those of a previous study that examined the coding of a series of complications among hospitalized patients (22). In that study, the sensitivity of ICD-9-CM codes 584 and 586 was 28% for the identification of a rise in serum creatinine of at least 2 mg/dl.

There are several potential explanations for the low sensitivity of ICD-9-CM codes for ARF. Although inattentive examination of medical records by professional chart reviewers may contribute, data suggest that physicians ultimately are responsible for most coding errors (23). Comorbidities and complications during hospitalization are particularly susceptible to underreporting (24,25). This is a particular problem for "secondary" conditions that physicians consider to be of lesser seriousness, especially for patients who are admitted with severe illnesses (26). Small changes in serum creatinine may go unnoticed or not be perceived as significant by the medical team. This is worrisome in light of recent findings that an increase in serum creatinine of only 0.3 mg/dl portends higher inpatient mortality (5).

A further impediment to the documentation of ARF is the inconsistent terminology surrounding this condition. Clinicians commonly use the phrases "acute or chronic renal failure" and "acute renal insufficiency" in verbal and written communication. This may prompt medical record abstractors either not to code ARF at all or to assign alternative codes that are less definitive. The most recent updates to the ICD-9-CM that took effect on October 1, 2005, clarified coding in chronic kidney disease but failed to correct the ambiguity associated with ARF coding (27).

The results from this study carry several implications for investigations of ARF using administrative data. For estimates of the incidence or prevalence of ARF, the code 584.x will provide a substantial underestimation of the actual disease burden of ARF as a result of low sensitivity; however, the estimate will not be inflated by false designations as a result of extremely high specificity (*i.e.*, low number of false-positive results) of the ICD-9-CM diagnosis code. Our finding that sensitivity was higher for more severe injury (as measured by change in serum creatinine) suggests that administrative data are not suitable for research studies in which the focus of interest is on very small changes in serum creatinine. The increase in sensitivity over time should be considered for studies that examine secular trends in the incidence of ARF.

PPV and NPV can be interpreted as measures of misclassifi-

cation when using ICD-9-CM diagnosis codes to assemble a cohort to study ARF as an exposure or outcome. A study that compares outcomes of patients with and without ARF, identified by ICD-9-CM codes, would suffer from some misclassification: A small percentage (≤5%) of the control group (without ARF) in fact would have ARF, and a substantial percentage (at least 20%, depending on the definition used and prevalence of ARF) of the ARF group in fact would not have ARF. If the misclassification were nondifferential (*i.e.*, independent of the outcome of interest), then the bias would be toward the null in estimates of relative risk. Assuming nondifferential misclassification, administrative databases with ICD-9-CM diagnosis codes may be of use in comparing outcomes among individuals with and without ARF. However, our finding that the sensitivity of the ICD-9-CM code for ARF was higher in patients who died during hospitalization suggests that estimates of the relative risk for death as a result of ARF from administrative data may be inflated.

Similar reasoning applies when using ICD-9-CM codes to identify ARF as an outcome. For example, a study that examines differences in the risk for ARF among patients who undergo two different surgical procedures may yield unbiased estimates, provided that misclassification of ARF is nondifferential with respect to type of procedure. However, a study of ARF in surgical *versus* medical patients would be more likely to provide biased estimates, as a result of the higher sensitivity of the ICD-9-CM codes for ARF in medical *versus* surgical patients. Biased estimates also may be obtained in studies that compare ARF in men and women and in the old *versus* the young, if the results from our stratified analyses are broadly generalizable.

Approximately 0.4% of patients who were admitted developed ARF-D, as assessed by ICD-9-CM codes. To assess the diagnostic performance of these codes, we studied randomly selected patients with ARF-D and those who were at highest risk for misclassification: Maintenance hemodialysis patients (who may have incorrectly received a diagnosis code for ARF) and those with the largest change in serum creatinine (who may have undergone dialysis but incorrectly did not receive the procedure code). Another approach to selecting the "control" group would have been to randomly select charts with no ICD-9 codes for ARF-D and then assign "false negative" or "true negative" on the basis of chart review. Most likely, we would have found all or nearly all to be "true negatives," given the relatively low prevalence of ARF-D in the hospitalized population (<1%). Adopting such a strategy would have inflated our estimates of NPV and specificity. Even with a conservative strategy of selecting patients who are at highest risk for misclassification, we found the codes for ARF-D to have specificity and NPV that exceeded 90%. Our estimate of sensitivity, however, likely was inflated as a result of the sampling strategy, which was designed to avoid overestimation of specificity and NPV, but may have undersampled among the "false negative" population. Extrapolating our findings to the entire population, we conservatively estimate that sensitivity may have been as low as 78%. This calculation is based on the following assumptions: 4% false-negative coding among ESRD

patients, 0.5% prevalence of ARF-D, and 50% sensitivity among nonsampled ARF-D cases. Our range of estimates for sensitivity are comparable to previous studies that demonstrated a sensitivity of 77 to 91% when coding of dialysis (acute and chronic) was compared with chart review (28,29). The high sensitivity and specificity suggest that accurate prevalence and incidence estimates of ARF-D can be obtained through administrative data. Also, the high predictive values support the use of administrative data to study ARF-D as an outcome and exposure.

The strengths of our analysis include the large study population, the inclusion of three hospitals with diverse patient populations, the use of objective serum creatinine–based definitions of ARF as diagnostic standards, and the conservative approach to chart review to investigate ARF-D. Limitations include that each of the hospitals is an academic medical center located in Boston. This may limit the generalizability of the results, particularly to nonteaching hospitals and to hospitals in other geographic regions if coding practices differ substantially. Our use of in-hospital serum creatinine values also may have led to misclassification of ARF as a diagnostic standard. Patients with a single spuriously high or low serum creatinine may have been misclassified as having ARF. Also, lack of access to preadmission serum creatinine values may have prevented the identification of some true cases of ARF.

The power of administrative data to address research questions in ARF may be enhanced by the development of standardized definitions for ARF, the introduction of clinically meaningful ICD-9-CM diagnosis codes, and further development of linked laboratory and administrative databases. We conclude that existing administrative data sets are a potentially powerful tool for research in ARF, although the use of ICD-9-CM codes will underestimate the disease burden of ARF. The excellent performance characteristics of ICD-9-CM codes for ARF-D suggest that administrative data sets may be particularly well suited for research in ARF-D.

Appendix: ICD-9-CM Diagnosis and Procedure Codes
ARF (any of the following)
- 584.5: ARF, with lesion of tubular necrosis
- 584.6: ARF, with lesion of renal cortical necrosis
- 584.7: ARF, with lesion of renal medullary (papillary) necrosis
- 584.8: ARF, with other specified pathologic lesion in kidney
- 584.9: ARF, unspecified

ARF-D
ARF code as above PLUS any of the following codes:
- V39.95: Hemodialysis
- V45.1: Renal dialysis status (patient requires intermittent renal dialysis; presence of arteriovenous shunt)
- V56.0: Extracorporeal dialysis (dialysis [renal] not otherwise specified)
- V56.1: Fitting and adjustment of extracorporeal dialysis catheter

ESRD
Absence of ARF code as above PLUS any of the following codes:
- 39.95: Hemodialysis
- 54.98: Peritoneal dialysis
- V45.1: Renal dialysis status (patient requires intermittent renal dialysis; presence of arteriovenous shunt)
- V56.0: Extracorporeal dialysis (dialysis [renal] not otherwise specified)
- V56.1: Fitting and adjustment of extracorporeal dialysis catheter
- V56.2: Fitting and adjustment of peritoneal dialysis catheter
- V56.31: Encounter for adequacy testing for hemodialysis
- V56.32: Encounter for adequacy testing for peritoneal dialysis
- V56.8: Other dialysis (peritoneal dialysis)

Other
- 55.69: Transplant of kidney
- 585: Chronic kidney disease

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