emerging issues: hospital admissions for infection

I learned to make my mind large, as the universe is large, so that there is room for paradoxes.

Maxine Hong Kingston, The Woman Warrior
During the past four years, mortality in the first year of dialysis has been a major focus for the USRDS. We initially assessed overall rates among hemodialysis and peritoneal dialysis patients, showing that, when adjusted for such factors as age, eGFR, BMI, and comorbidity, mortality did not differ between the two populations. We next assessed monthly mortality rates, illustrating the recent increase in mortality during the first months of therapy. And in the 2009 ADR we addressed hospitalization, showing a marked rise — across ages — in infectious hospitalizations during the first four months after initiation.

These data, along with information on high rates of catheter use, have led us to investigate both inpatient infectious events and outpatient antibiotic use, which, for IV antibiotics, has increased in the past decade. To define the burden of illness in the early months on dialysis, we this year present more detailed assessments of infectious hospitalizations. On the next page, for instance, we illustrate monthly first-year hospitalization rates for vascular access infections. Among patients age 20–44, the rate in month three of therapy is 3.4 times higher than in 1991, a greater increase than that seen in older populations. Such data raise major public health concerns about catheter use and about infection control in dialysis units.

Cause-specific data show that the rate of hospitalization for vascular access infections appears to be declining. Since 2000, however, hospitalizations for bacteremia/sepsis have been on the rise, a change which parallels the increasing use of cuffed catheters. These catheters may be used for longer periods, with subsequent episodes of bacteremia and sepsis requiring hospitalization. Patients who start therapy with only a catheter have the highest overall rates of infectious hospitalization, particularly in the first four months; hospitalizations for bacteremia/sepsis are also greatest in these patients, but are also high in those with both a catheter and a maturing internal access. Geographic variations in hospitalizations for overall and vascular access infections demonstrate that a focus on infection control needs to be made by dialysis units, state surveyors, and local departments of health.
We next present data on the use of both intravenous (IV) and oral antibiotics, and on the relation between mortality and antibiotic use in the 30 days prior to death. In the first six months of hemodialysis therapy, for example, more than 60 percent of patients with a catheter have an antibiotic claim, compared to 40 percent of those with an arteriovenous (AV) fistula. We then examine infectious complications in the prevalent population, showing that rates of hospitalization — for overall infections, for vascular access infections, and for bacteremia/sepsis — are considerably higher, regardless of patient vintage, in both whites and African Americans using a catheter rather than an AV fistula or graft. Among patients with a vintage of five or more years, the rate of hospitalization for vascular access infection is greater among African Americans than among whites. Since African Americans have lower rates of mortality on dialysis, this long-term complication needs to be addressed through improved methods of infection control.

The breadth of data presented in this chapter demonstrates that the rate of infectious complications has increased during the past decade, and that these complications are consistently associated with the use of catheters. Despite recent reductions in catheter placement rates — which may simply reflect the increased use of cuffed catheters — it is clear that these devices are prone to infectious complications at a rate greater than that of arteriovenous fistulas and grafts, evidence for the use of practices that promote early removal of catheters and replacement with an internal access. Infection control procedures, including the use of antibiotic locks, access site cleaning, and treatment with antibiotic ointments, should also be considered; their use in clinical practice is unknown. And geographic variations in rates of infectious complications merit further assessment.

**Figure 1:** See page 470 for analytical methods. *Incident hemodialysis patients age 20 & older. Adj: gender/race/primary diagnosis; ref: incident hemodialysis patients, 2005.*
Rates of admission for all-cause infection have shown modest growth across all age groups since 1991, and, in patients age 65 and older, are highest in the early months following initiation. For these older patients starting therapy in 2007, for example, rates ranged from 1,014 admissions per 1,000 patient years in the first month of treatment to 541 during months 10–<12.

By gender, 2007 admission rates in the months following initiation were 9.2–14.0 percent lower in men than in women, reaching 663 and 730 in months 3–<4, respectively, and 504 and 586 in months 10–<12.

Admissions by race in 2007 were similar in whites and African Americans during the early months following initiation, at 706 and 700 per 1,000 patient years, respectively. In months 6–<8 and 10–<12, however, rates were 4.5–5.1 percent lower in whites, at 601 and 539 per 1,000 patient years compared to 629 and 568 in African Americans.

Compared to those in patients with a primary diagnosis of hypertension or glomerulonephritis, rates of admission for all-cause infection in patients whose ESRD is caused by diabetes are 13–26 and 21–35 percent higher, respectively, in the first year of therapy. For these patients starting therapy in 2007, for example, rates ranged from 1,280 to 561 in the first month of treatment to 627 and 487 during months 10–<12.

By gender, 2007 admission rates in the months following initiation were 6.2–13.0 percent lower in men than in women, reaching 959 and 1,024 in months 3–<4, respectively, and 747 and 811 in months 10–<12.

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Adjusted rates of admission for vascular access infections in the first year of hemodialysis appear to be declining, as evidenced by decreases of 6.5–11.0 percent between 2005 and 2007. In 2007, rates at months 3–<4, 6–<8, and 10–<12 were 229, 170, and 126 per 1,000 patient years, respectively.

Admissions for pneumonia in the first year have remained relatively stable since the late 1990s, and in 2007 were 80, 77, and 90 per 1,000 patient years, respectively, in months 3–<4, 6–<8, and 10–<12.

After showing modest declines in the late 1990s, admissions for bacteremia/septicemia have begun to trend upward — 30 to 36 percent since 2002 — and in 2007 reached their highest rates since 1991, at 180 per 1,000 patient years in months 3–<4, and 129 in months 10–<12.

Rates of admission for urinary tract infection are comparatively lower than those for vascular access, pneumonia, or bacteremia/septicemia. Historically, rates during months 3–<4 post-initiation have been slightly higher than those in months 6–<8 and 10–<12, but in 2007 rates over the first year began to converge, reaching 33, 34, and 28 per 1,000 patient years, respectively. 

*Figures 1, 6–9; see page 470 for analytical methods. Incident hemodialysis patients, age 20 & older. Adj: age/gender/race/primary diagnosis; ref: incident hemodialysis patients, 2005.*
For hemodialysis patients incident in 2006–2007, rates of admission for all-cause infection in the first months of therapy were highest in those initiating with a catheter or a catheter and maturing internal access. In white and African American patients with catheters only, for example, rates in month one were 1,195 and 1,365 per 1,000 patient years, respectively, compared to 355 and 382 for those with an arteriovenous (AV) fistula. Rates over the course of the year fell most dramatically in catheter patients—44 to 61 percent—while decreases were more modest in AV fistula and graft patients, at 7.0–26 and 9–28 percent, respectively. See page 470 for analytical methods. Incident hemodialysis patients, 2006–2007, age 65 & older. Adj: age/gender/primary diagnosis; ref: incident hemodialysis patients age 65 & older, 2005.

Among patients starting hemodialysis with either a catheter or a catheter and maturing internal access, admissions for vascular access infections tend to fall during the first year of therapy. Rates among whites initiating in 2006–2007 with a catheter only, for example, fell from 320 per 1,000 patient years at risk in month one to 119 in month 12; among whites starting with both a catheter and an internal access, the rate declined from 351 to 68. Rates for patients initiating with an AV fistula tend to fall slightly in the second half of the year and then increase; rates for those beginning with an AV graft are more variable during the year. See page 470 for analytical methods. Incident hemodialysis patients, 2006–2007, age 65 & older. Adj: age/gender/primary diagnosis; ref: incident hemodialysis patients age 65 & older, 2005.
In the first six months of hemodialysis, overall rates of admission for all-cause infection among 2006–2007 incident patients age 65 and older exceeded 1,000 per 1,000 patient years in Ohio and Louisiana. For patients with catheters only, the highest rates — above 1,200 — occurred in Ohio, New Jersey, and Louisiana. Rates were lower for patients who also had a maturing internal access, reaching highs of 913–914 in Idaho and Delaware. Admissions for vascular access infection during the first six months of hemodialysis tend to be lowest in the upper Midwestern states, and highest in states such as Florida, South Carolina, and New Jersey. + FIGURES 1.13–14; see page 470 for analytical methods. Incident hemodialysis patients, 2006–2007, age 65 & older; unadjusted.
In 2007, the percentage of hemodialysis patients with an antibiotic claim in the first six months of treatment was 4–8 percent higher in patients on IV antibiotics compared to those on oral antibiotics, reaching 13.1 and 9.1 percent, respectively, in month six. And for both types of medication, the percentage of claims was approximately 2 percent higher in whites than in African Americans. \( \text{FIGURE 1.15; see page 471 for analytical methods. Incident hemodialysis patients with Part D coverage, 2007.} \)

The percentage of hemodialysis patients with at least one outpatient culture claim in the first six months of treatment averages 5.4 percent overall and 6.2 and 4.1 percent, respectively, in whites and African Americans. \( \text{FIGURE 1.16; see page 471 for analytical methods. Incident hemodialysis patients with Part D coverage, 2007.} \)

In 2007, 45 percent of incident hemodialysis patients had at least one claim for an IV antibiotic in the first six months of therapy, and 27 percent had at least one claim for an oral antibiotic. For both antibiotic types, use was slightly higher among white patients than among African Americans. \( \text{FIGURE 1.17; see page 471 for analytical methods. Incident hemodialysis patients with Part D coverage, 2007.} \)
Hemodialysis patients using a catheter for dialysis access are the most likely to have at least one IV or oral antibiotic claim during the first six months of dialysis, at 62 percent compared to 56.2 and 39.7 percent, respectively, in those with a catheter and maturing fistula or fistula only. By race, 64 percent of whites with a catheter have at least one claim, compared to 59 percent of African Americans. For patients with either a catheter and maturing fistula or a fistula only, 58 and 41 percent, respectively, of whites have at least one claim compared to 52 and 36 percent of African Americans. Claims for at least one culture in the first six months of therapy are slightly higher in patients using a catheter, at 25 percent compared to 23 and 17 percent in those with either a catheter with maturing fistula or a fistula only, and higher in whites than in African Americans. + Figures 1.18–19; see page 471 for analytical methods. Incident hemodialysis patients with Part D coverage, 2007.

The cumulative percentage of hemodialysis patients with an antibiotic claim during 2007 reached 42 in those on IV antibiotics, and 49 in those using oral antibiotics. Claims in patients using a catheter for dialysis access far outweigh claims by those with a fistula. In patients on IV antibiotics, for example, 63 percent with a catheter have claims by the end of the year compared to 32 percent of those with a fistula. In patients on oral antibiotics, the percentage of claims is also higher for patients with a catheter, but the difference is not as extreme, at 54 and 47 percent, respectively. + Figures 1.20–21; see page 471 for analytical methods. January 1 point prevalent hemodialysis patients with Part D coverage who are also in the ESRD CPM database. Access represents the current access recorded in the 2008 ESRD CPM data.
For prevalent hemodialysis patients with a catheter, rates of admission for all-cause infection vary by vintage, or time on dialysis. White and African American patients on dialysis less than two years, for example, have rates per 1,000 patient years of 806–814, compared to 984–1,043 for those with a vintage greater than two years. Rates among patients using an arteriovenous (AV) fistula vary less by vintage, and those for patients with an AV graft are higher in the earlier years of therapy.

Admissions for vascular access infection among patients with a catheter vary by vintage and race. Among whites, rates are highest for those on dialysis 2–<5 years, reaching 456 per 1,000 patient years, while the highest rates among African American patients occur in those with a vintage of five or more years, at 524. Admissions are far less frequent among patients with an AV fistula, reaching a high of just 39 among African Americans with the longest vintage, while the highest rates for patients with an AV graft occur among whites with a vintage of 2–<5 years, at 120.

Admissions for bacteremia/septicemia show no clear pattern by vintage. Among patients with a catheter, rates by race are highest for whites and African Americans, while patients of other races generally have the highest rates among those with an AV fistula or graft.† Figures 22–24; see page 470 for analytical methods. Prevalent hemodialysis patients, age 20 & older, reaching day 90 of ESRD on or before October 1, 2007, & followed for admissions in 2008; ESRD CPM & Medicare claims data. Adj: age/gender/primary diagnosis; ref: prevalent hemodialysis patients, 2005, in both the CPM & USRDS databases.
The percentage of patients with an antibiotic claim in the first thirty days following an inpatient hospitalization for all-cause infection is slightly higher overall in patients with a catheter, similar in whites and African Americans, and considerably higher for patients with an antibiotic administered via an intravenous rather than oral route.

Among patients hospitalized for a vascular access infection, the percentage with an antibiotic claim in the first thirty days following hospital discharge is similar in whites regardless of access type, at 64–66 percent. In African Americans, the highest percentage of overall claims occurs in patients with a catheter, at 63 percent, compared to 59 and 54 percent, respectively, in patients with an arteriovenous (AV) fistula or AV graft. In all instances, claims for IV antibiotics are much more common than claims for oral antibiotics.

The percentage of patients with an antibiotic claim following hospitalization for bacteremia/septicemia is also similar in white patients regardless of access type, at 51–53 percent. Among African Americans with an AV graft, 61 percent have an antibiotic claim in the first thirty days post-discharge, compared to 51 and 46 percent, respectively, of patients with a catheter or AV fistula.

Among incident hemodialysis patients in 2006–2007 who died before the end of 2007, the percentage with an antibiotic claim thirty days prior to death varied little by race for all-cause mortality, but was higher in patients who died in the hospital than in those whose death occurred outside the hospital. Overall, the percentage of patients with antibiotic claims was 15–16 for in-hospital death compared to 12–13 for those dying outside the hospital. For patients dying in the hospital, iv antibiotic claims were more common than claims for oral antibiotics in both whites and African Americans; among those dying outside the hospital, in contrast, the percentages of patients with oral or iv antibiotic claims were similar by race.

Antibiotic claims from patients with a cardiac death reached 12–17 percent in patients who died in the hospital and 10–14 percent for those who died outside the hospital. For in-hospital deaths, whites had a higher percentage of antibiotic claims than African Americans, and there were slightly more iv claims than oral claims for patients of both races. For those dying outside the hospital, oral and iv antibiotic claims were evenly distributed among both whites and African Americans.

Antibiotic claims from patients suffering an infectious death were 15–19 percent in those who died in the hospital and 14–18 percent for those whose death occurred outside the hospital. In both settings, iv claims outnumbered oral claims. And for deaths occurring outside the hospital, claims for iv antibiotics were two to three times more likely than claims for oral antibiotics in both whites and African Americans.

* Figures 1.28–30; see page 471 for analytical methods. Incident hemodialysis patients, 2006–2007, who died before the end of 2007.
Among 2006–2007 incident hemodialysis patients who died before the end of 2007, the percentage of patients with antibiotic claims thirty days prior to death (all-cause) was highest overall in those with catheters and arteriovenous (AV) grafts. In patients who died in the hospital, the percentages were 16.4 and 15.4, respectively, compared to 13.5 and 12.5 in those who died outside the hospital. Claims for those with AV fistulas were lower, at 8.5 and 8.3 percent. There was no distinct pattern in antibiotic type for either site of death.

Of patients suffering an in-hospital cardiac death, 15.3, 7.2, and 12.2 percent of those with a catheter, AV fistula, or AV graft, respectively, had an antibiotic claim, compared to 14.3, 9.8, and 13.5 percent in those whose death occurred outside the hospital. The use of IV antibiotics was slightly more common in patients with catheters and AV grafts.

For infectious mortality, antibiotic use among patients who died in the hospital with a catheter or AV graft reached 19.3 and 17.5 percent, respectively, compared to 15.5 and 16.0 percent in those dying outside the hospital. Claims from patients with AV fistulas were much lower, at 9.4 and 11.9 percent. By site of death, IV antibiotics were generally chosen more frequently than oral antibiotics in both settings. For analytical methods, see page 471. Incident hemodialysis patients, 2006–2007, who died before the end of 2007.
Adjusted rates of admission for vascular access infections in the first year of dialysis appear to be declining, as evidenced by decreases of 6.5–11.0 percent between 2005 and 2007. Figure 1.6

After showing modest declines in the late 1990s, admissions for bacteremia/septicemia have begun to trend upward—30 to 36 percent since 2002—and in 2007 reached their highest rates since 1991, at 180 per 1,000 patient years in months 3–4 after hemodialysis initiation, and 129 in months 10–12. Figure 1.8

For hemodialysis patients incident in 2006–2007, rates of admission for all-cause infection in the first months of hemodialysis were highest in those initiating with a catheter or a catheter and maturing internal access. Figure 1.10

Hemodialysis patients using a catheter for dialysis access are the most likely to have at least one IV or oral antibiotic claim during the first six months of dialysis. Figure 1.18

Admissions for vascular access infection among patients with a catheter vary by vintage and race, with rates among whites highest for those on dialysis 2–5 years, at 456 per 1,000 patient years, and rates among African Americans highest in those with a vintage of five or more years, at 524. Figure 1.23

Among 2006–2007 incident patients who died before the end of 2007, the percentage with antibiotic claims thirty days prior to death (all-cause) was highest overall in those with a catheter or arteriovenous graft, and lowest in those with an arteriovenous fistula. Figure 1.31