WEEKEND COMPARED WITH WEEKDAY PRESENTATIONS OF PERITONEAL DIALYSIS-ASSOCIATED PERITONITIS

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♦ **Objective:** Management of peritoneal dialysis (PD)-associated peritonitis requires timely intervention by experienced staff, which may not be uniformly available throughout the week. The aim of the present study was to examine the effects of weekend compared with weekday presentation on peritonitis outcomes.

♦ **Methods:** The study, which used data from the Australia and New Zealand Dialysis and Transplant Registry, included all Australian patients receiving PD between 1 October 2003 and 31 December 2008. The independent predictors of weekend presentation and subsequent peritonitis outcomes were assessed by multivariate logistic regression.

♦ **Results:** Peritonitis presentation rates were significantly lower on Saturdays [0.46 episodes per year; 95% confidence interval (CI): 0.42 to 0.49 episodes per year] and on Sundays (0.43 episodes per year; 95% CI: 0.40 to 0.47 episodes per year) than all other weekdays; they peaked on Mondays (0.76 episodes per year; 95% CI: 0.72 to 0.81 episodes per year). Weekend presentation with a first episode of peritonitis was independently associated with lower body mass index and residence less than 100 km away from the nearest PD unit. Patients presenting with peritonitis on the weekend were significantly more likely to be hospitalized [adjusted odds ratio (OR): 2.32; 95% CI: 1.85 to 2.90], although microbial profiles and empiric antimicrobial treatments were comparable between the weekend and weekday groups. Antimicrobial cure rates were also comparable (79% vs 79%, $p=0.9$), with the exception of cure rates for culture-negative peritonitis, which were lower on the weekend

(80% vs 88%, $p=0.047$). Antifungal prophylaxis was less likely to be co-prescribed for first peritonitis episodes presenting on weekdays (OR: 0.68; 95% CI: 0.05 to 0.89).

♦ **Conclusions:** Patients on PD are less likely to present with peritonitis on the weekend. Nevertheless, the microbiology, treatment, and outcomes of weekend and weekday PD peritonitis presentations are remarkably similar. Exceptions include the associations of weekend presentation with a higher hospitalization rate and a lower cure rate in culture-negative infection.

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Although most hospitals operate 24 hours per day, 7 days per week, staffing levels and service offerings tend to be lower on weekends than on weekdays, both numerically and in terms of expertise available on site (1,2). Patients may also be more reluctant to attend hospital on a weekend. A growing number of studies examining temporal variation in health services outcomes have reported appreciable increases in mortality and other adverse clinical outcomes on weekends compared with weekdays (2–4), particularly for conditions in which the timeliness of treatment affects outcomes (3,4).

No such studies have been performed to date for dialysis services. In view of the fact that peritonitis is a frequent serious complication of peritoneal dialysis (PD) (5–16), accounting for 30% of technique failures and 21% of infectious deaths among PD patients in Australia and New Zealand (17), and that peritonitis is

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considered to require prompt treatment by experienced clinicians to achieve good outcomes (18), weekend presentations with PD peritonitis could potentially engender poorer results.

The aim of the current study was to evaluate the predictors of weekend and weekday presentations with PD-associated peritonitis and to determine the effects of such presentations on the microbiology, treatment, and clinical outcomes of PD-associated peritonitis in all Australian PD patients, as recorded in the Australia and New Zealand Dialysis and Transplant Registry (ANZDATA).

METHODS

STUDY POPULATION

The study included all Australian adult patients from ANZDATA who were receiving PD between 1 October 2003 (when detailed peritonitis data started to be collected) and 31 December 2008. The data collected included demographics, cause of primary renal disease, comorbidities at the start of dialysis, smoking status, body mass index (BMI), late referral (defined as dialysis start within 3 months of referral to a nephrologist), date and microbiology of peritonitis episodes (up to 3 organisms for polymicrobial episodes), and the initial and subsequent antibiotic treatment regimens. Center size was categorized in quartiles according to the number of patients in the care of individual units over the duration of the study: small (<7 patients), small-medium (7 – 42 patients), medium-large (43 – 140 patients), and large (>140 patients). The data were collected throughout the calendar year by medical and nursing staff in each renal unit and were submitted annually to ANZDATA by the end of March the following year.

Patients were analyzed according to the day of the week that they presented with peritonitis. "Weekend" was defined as the period starting midnight Friday and ending midnight Sunday; "weekday" was defined as the remainder of the week. Peritonitis was defined as the clinical features of peritonitis (abdominal pain or cloudy dialysate) and dialysate leukocytosis (white blood cell count exceeding 100/ μ L, with more than 50% neutrophils). Peritonitis rates were calculated according to the recommendations from the International Society for Peritoneal Dialysis (19,20).

The outcomes examined were peritonitis rate, microbial profile, antimicrobial therapy, cure, relapse, peritonitis-associated hospitalization, catheter removal, temporary transfer to hemodialysis (in which patients subsequently resumed PD), permanent transfer to hemodialysis, and patient death. A peritonitis episode was

considered "cured" by antibiotics alone if the patient was symptom-free, with clear PD effluent, and if the episode was not complicated by relapse, catheter removal, or death. Peritonitis-associated death was recorded if a patient died within 30 days of peritonitis presentation. In view of the complexities associated with analyzing multiple events in individuals, where the assumption of independence of observations is not appropriate, the primary analyses focused on first episodes of peritonitis in each individual. The exceptions are peritonitis rates, for which all episodes were considered. Secondary sensitivity analyses included all peritonitis episodes, in which the multivariable adjustment included fixed effects for first compared with subsequent presentations.

STATISTICAL ANALYSIS

Results are expressed as frequencies and percentages, mean $\pm$ standard deviation, or median and 25th – 75th percentile range, as appropriate. Differences between groups were analyzed using the chi-square test for categorical data, the unpaired t-test for normally distributed continuous data, and the Kruskal–Wallis test for non-normally distributed continuous data. Peritonitis rates were compared using Poisson regression analysis. The independent predictors of weekend presentations of peritonitis were determined using multivariate logistic regression, with backward stepwise elimination until the most parsimonious model was identified. Age, sex, racial origin, BMI, estimated glomerular filtration rate at dialysis start, late referral, cause of end-stage renal failure, smoking status, comorbidities, peritoneal transport status, time on PD, PD modality at the time of peritonitis, center size, and distance of patient residence from the nearest PD unit were included in the model as covariates. The effects of weekend presentations on the outcomes of PD peritonitis were also assessed by multivariate logistic regression. First-order interaction terms between the significant covariates were examined where appropriate. Data were analyzed using the software packages PASW Statistics for Windows (release 18.0: SPSS, North Sydney, Australia). Values of p less than 0.05 were considered statistically significant.

RESULTS

PERITONITIS RATES

During the study period, 6610 patients received PD in Australia, being followed for 10 470 patient-years (mean follow-up: 1.58 years per patient). In this group, 3128 patients (47%) experienced 6213 episodes

of peritonitis in (range: 1 – 15 episodes per patient). The overall peritonitis rate was 0.59 episodes [95% confidence interval (CI): 0.58 to 0.61 episodes] per patient-year of treatment (equivalent to 20.2 patient-months between episodes).

When peritonitis rates were analyzed according to day of presentation, the rates were significantly lower on Saturdays (0.46 episodes per patient-year; 95% CI: 0.42 to 0.49 episodes per patient-year) and on Sundays (0.43 episodes per patient-year; 95% CI: 0.40 to 0.47 episodes per patient-year) than on all weekdays (Figure 1); they peaked on Mondays (0.76 episodes per patient-year; 95% CI: 0.72 to 0.81 episodes per patient-year). Overall, weekend peritonitis rates (0.45 episodes per patient-year; 95% CI: 0.42 to 0.47 episodes per patient-year) were significantly lower than weekday peritonitis rates (0.65 episodes per patient-year; 95% CI: 0.63 to 0.67 episodes per patient-year). Compared with weekend presentations, the incidence rate ratio for weekday peritonitis presentations was 1.46 (95% CI: 1.38 to 1.56). When only first episodes of peritonitis were considered ($n = 3218$), the number of observed weekend presentations (690 episodes, 21%) was significantly less than the expected number (894 episodes, 28%, $p < 0.001$). Similarly, when all episodes of peritonitis were considered ($n = 6213$), the number of observed weekend presentations (1333 episodes, 21%) was also significantly less than the expected number (1775 episodes, 29%, $p < 0.001$).

PREDICTORS OF WEEKEND PRESENTATION WITH PERITONITIS

The characteristics of patients presenting with a first episode of peritonitis on a weekend or a weekday were similar (Table 1), except that weekend patients had a

Figure 1 — Peritonitis rates and 95% confidence intervals (marked by whiskers) for all Australian patients receiving peritoneal dialysis between 1 October 2003 and 31 December 2008, according to day of peritonitis presentation.

significantly lower BMI, had been on PD for a longer period, and were less likely to live more than 100 km from the nearest PD unit. There was also a trend to fewer Aboriginal and Torres Strait Islander peoples presenting with their first episode of peritonitis on a weekday. Using multivariate logistic regression analysis, the significant independent predictors of a lower probability of weekend presentation with a first peritonitis episode were lower BMI [adjusted odds ratio (OR): 0.98; 95% CI: 0.96 to 1.00] and residence more than 100 km from the nearest PD unit (OR: 0.58; 95% CI: 0.38 to 0.88).

MICROBIOLOGY OF WEEKEND AND WEEKDAY PERITONITIS EPISODES

Table 2 summarizes the micro-organisms isolated from dialysate cultures during first or subsequent episodes of peritonitis on the weekend or weekday during the study period. Streptococci were more likely to be isolated from first peritonitis episodes with weekend presentations than from those with weekday presentations (12% vs 8% respectively, $p = 0.002$). Otherwise, the microbial profiles of weekend and weekday peritonitis episodes were similar.

INITIAL EMPIRIC ANTIBIOTIC TREATMENT OF WEEKEND VERSUS WEEKDAY PERITONITIS EPISODES

Most patients with peritonitis were treated initially with either intraperitoneal cephazolin in combination with gentamicin (weekend 36% vs weekday 35%) or intraperitoneal vancomycin in combination with gentamicin (weekend 31% vs weekday 34%).

Overall, empiric treatment of a first peritonitis episode was very similar regardless of whether patients presented on the weekend or on a weekday ($p = 0.7$). However, adjunctive therapy of peritonitis did differ between the groups, insofar as patients presenting on the weekend were significantly more likely than patients presenting on a weekday to receive antifungal prophylaxis (first episodes: 13% vs 8%, $p = 0.001$). Using multivariate logistic regression analysis, antifungal prophylaxis was less likely to be co-prescribed for a first peritonitis episode with a weekday presentation (OR: 0.68; 95% CI: 0.05 to 0.89), for older patients (OR: 0.99; 95% CI: 0.98 to 0.99), for patients living more than 100 km from a PD unit (OR: 0.44; 95% CI: 0.22 to 0.91), and for patients being treated in smaller centers (using largest quartile as reference, smallest-quartile OR: 0.48; 95% CI: 0.06 to 3.90; second-quartile OR: 0.25; 95% CI: 0.08 to 0.78; third-quartile OR: 0.63; 95% CI: 0.45 to 0.89). Patients with a higher BMI were more likely to receive antifungal

TABLE 1
 Characteristics of Australian Peritoneal Dialysis (PD) Patients Presenting with a First Episode of Peritonitis on
 Either the Weekend or a Weekday During the Study Period, 2003 – 2008

Characteristic	Timing of presentation with first peritonitis			<i>p</i> Value
	Overall	Weekend	Weekday	
Patients (<i>n</i>)	3128	690	2438	—
Women [<i>n</i> (%)]	1420 (45)	313 (45)	1107 (45)	1.0
Mean age (years)	59.7±16.5	59.6±17.0	59.8±16.3	0.9
Racial origin [<i>n</i> (%)]				0.07
Caucasian	2279 (73)	520 (75)	1759 (72)	
ATSI	326 (10)	56 (8)	270 (11)	
MPI	91 (3)	14 (2)	77 (3)	
Asian	297 (9)	65 (9)	232 (10)	
Other	135 (4)	35 (5)	100 (4)	
Mean BMI (kg/m ²)	26.2±5.4	25.8±5.4	26.3±5.3	0.03
Mean eGFR (mL/min/1.73 m ²) ^a	7.1±4.5	7.1±4.3	7.2±4.6	0.8
Late referral [<i>n</i> (%)]	745 (24)	153 (22)	592 (24)	0.3
Cause of ESRF [<i>n</i> (%)]				0.9
Chronic glomerulonephritis	844 (27)	190 (28)	654 (27)	
Diabetic nephropathy	982 (31)	210 (30)	772 (32)	
Renovascular disease	425 (14)	91 (13)	334 (14)	
Polycystic kidney	168 (5)	43 (6)	125 (5)	
Reflux nephropathy	118 (4)	26 (4)	92 (4)	
Other	406 (13)	85 (12)	321 (13)	
Unknown	185 (6)	45 (7)	140 (6)	
Smoking status [<i>n</i> (%)]				0.5
Current	394 (13)	78 (11)	316 (13)	
Former	1177 (38)	259 (38)	918 (38)	
Never	1557 (50)	353 (51)	1204 (49)	
Comorbidity [<i>n</i> (%)]				
Chronic lung disease	426 (14)	80 (12)	346 (14)	0.08
Coronary artery disease	1139 (36)	250 (36)	889 (36)	0.9
Peripheral vascular disease	683 (22)	152 (22)	531 (22)	0.9
Cerebrovascular disease	434 (14)	94 (14)	340 (14)	0.8
Diabetes mellitus	1260 (40)	257 (37)	1003 (41)	0.07
Peritoneal transport status [<i>n</i> (%)]				0.7
High	360 (12)	81 (12)	279 (11)	
High average	1195 (38)	273 (40)	922 (38)	
Low average	754 (24)	168 (24)	586 (24)	
Low	141 (5)	33 (5)	108 (4)	
Unknown/not specified	678 (22)	135 (20)	543 (22)	
PD modality [<i>n</i> (%)]				0.2
CAPD	1519 (49)	319 (46)	1200 (49)	
APD	1609 (51)	371 (54)	1238 (51)	
Time on PD (years)				0.007
Median	0.63	0.71	0.61	
Range	0.24–1.37	0.29–1.48	0.23–1.34	
Center size [<i>n</i> (%)]				0.5
Small (<7 patients)	18 (1)	2 (0)	16 (1)	
Small-medium (7–42 patients)	167 (5)	34 (5)	133 (5)	
Medium-large (43–140 patients)	688 (22)	141 (20)	527 (22)	
Large (>140 patients)	2275 (73)	513 (74)	1762 (72)	

TABLE 1 (cont'd.)

Characteristic	Timing of presentation with first peritonitis			<i>p</i> Value
	Overall	Weekend	Weekday	
Distance from PD unit [<i>n</i> (%)]				0.02
<100 km	2915 (93)	654 (95)	2261 (93)	
≥100 km	193 (6)	29 (4)	164 (7)	
Unknown	20 (1)	7 (1)	13 (1)	

ATSI = Aboriginal or Torres Strait Islander; MPI = Maori or Pacific Islander; BMI = body mass index; eGFR = estimated glomerular filtration rate; ESRF = end-stage renal failure; CAPD = continuous ambulatory peritoneal dialysis; APD = automated peritoneal dialysis.

^a At dialysis start.

TABLE 2

Micro-organisms Isolated from Dialysate Cultures of All Australian Peritoneal Dialysis Patients During First Episodes of Peritonitis on Either the Weekend or a Weekday During the Study Period, 2003 – 2008

Micro-organism [<i>n</i> (%)]	Timing of presentation with first peritonitis		<i>p</i> Value
	Weekend	Weekday	
Culture-negative	91 (13)	355 (15)	0.4
Gram-positive	368 (53)	1302 (53)	1.0
<i>Staphylococcus aureus</i>	80 (12)	308 (13)	0.5
CNS	157 (23)	632 (26)	0.09
Streptococci	82 (12)	198 (8)	0.002
Enterococci	25 (4)	101 (4)	0.5
<i>Corynebacterium</i>	17 (2)	41 (2)	0.2
<i>Pseudomonas</i>	34 (5)	132 (5)	0.6
NPGN	171 (25)	601 (25)	0.9
Fungal	26 (4)	96 (4)	0.8
<i>Mycobacterium</i>	2 (0.3)	9 (0.4)	0.8
Polymicrobial	87 (13)	296 (12)	0.7
TOTAL	690	2438	

CNS = coagulase-negative staphylococci; NPGN = non-pseudomonal gram-negative.

prophylaxis (OR: 1.04; 95% CI: 1.01 to 1.06). Given that hospitalization may have influenced the propensity to prescribe antifungal prophylaxis, this covariate was included in the models. Not being admitted to hospital for peritonitis was independently predictive of a lower probability of antifungal prophylaxis (first-episode OR: 0.50; 95% CI: 0.36 to 0.69; all-episodes OR: 0.40; 95% CI: 0.31 to 0.51). However, weekday presentations were still independently associated with lower rates of antifungal prophylaxis (first-episode OR: 0.74; 95% CI: 0.56 to 0.98; all-episodes OR: 0.80; 95% CI: 0.65 to 0.98).

Compared with weekday presentations, weekend presentations of first peritonitis episodes involved comparable frequencies of heparin administration (22% vs 23% respectively, *p* = 0.4) and thrombolytic agent administration (0.3% vs 0.3% respectively, *p* = 0.9).

OUTCOMES OF FIRST AND SUBSEQUENT PERITONITIS EPISODES

Table 3 shows the outcomes of first or subsequent peritonitis episodes according to weekend and weekday presentation. Overall cure rates were comparable between the groups (first-episode rate: 79% vs 79%; *p* = 0.9). Indeed, all peritonitis outcomes were similar, except that patients presenting with a first episode of peritonitis on the weekend were significantly more likely to be hospitalized (83% vs 69%, *p* < 0.001) and to spend a shorter period of time in hospital (median duration: 5 days vs 6 days; *p* = 0.004).

Using multivariate logistic regression analysis, weekend presentation was a significant independent predictor of hospitalization for a first peritonitis episode (OR: 2.32; 95% CI: 1.85 to 2.90). Weekend presentation

TABLE 3
Clinical Outcomes of First Peritonitis Episodes in Australian Peritoneal Dialysis Patients Presenting on Weekends or Weekdays During the Study Period, 2003 – 2008

Outcome	Timing of presentation with first peritonitis ^a		<i>p</i> Value
	Weekend (<i>n</i> =690)	Weekday (<i>n</i> =2438)	
Cure with antibiotics [<i>n</i> (%)]	543 (79)	1915 (79)	0.9
Relapse [<i>n</i> (%)]	9 (1)	36 (1)	0.7
Hospitalization [<i>n</i> (%)]	575 (83)	1677 (69)	<0.001
Duration (days)			0.004
Median	5	6	
Range	3–10	3–12	
Catheter removal [<i>n</i> (%)]	134 (19)	438 (18)	0.4
Time to removal (days)			0.1
Median	6	7	
Range	3–10	3–13	
Temporary switch to HD [<i>n</i> (%)]	24 (3)	80 (3)	0.8
Time to switch (days)			0.4
Median	5.5	7	
Range	4–9	3–11	
Time on HD (days)			0.3
Median	73.5	66.5	
Range	44–109	20–94	
Permanent switch to HD [<i>n</i> (%)]	108 (16)	371 (15)	0.8
Time to switch (days)			0.2
Median	6	7	
Range	4–11	4–13	
Peritonitis-associated death ^b [<i>n</i> (%)]	35 (5)	127 (5)	0.9
Time to death (days)			0.2
Median	14	8	
Range	4–22	2–17	

HD = hemodialysis.

^a Group differences were assessed using the chi-square or Mann–Whitney test, as appropriate.

^b Within 30 days of peritonitis.

was not significantly associated with the outcomes of cure, catheter removal, temporary or permanent transfer to hemodialysis, or peritonitis-associated death. The number of relapse events was too small to permit adequate statistical analysis.

In light of the possibility that weekend presentation might have had a greater potential impact on the outcomes of more serious forms of peritonitis, a series of subgroup analyses were performed by causative micro-organism. Compared with weekday presentations, weekend presentations with a first episode of culture-negative peritonitis were associated with lower cure rates (80% vs 88%, *p* = 0.047), which were primarily a result of a higher catheter removal rate (19% vs 9%, *p* = 0.006) and a higher rate of permanent transfer to hemodialysis (19% vs 7%, *p* = 0.001). No differences in rates of cure with antimicrobial agents alone were observed

for weekend and weekday presentations of first episodes of peritonitis attributable to fungi (15% vs 9% respectively, *p* = 0.4), to *Pseudomonas* (56% vs 52%, *p* = 0.7), to non-pseudomonal gram-negative organisms (70% vs 68%, *p* = 0.5), to enterococci (60% vs 63%, *p* = 0.8), to *Staphylococcus aureus* (81% vs 75%, *p* = 0.2), to streptococci (82% vs 88%, *p* = 0.1), to *Corynebacterium* (88% vs 85%, *p* = 0.8), and to polymicrobial episodes (63% vs 57%, *p* = 0.3). There were also no differences in relapse rates, catheter removal, hemodialysis transfer, or death between weekend and weekday presentations for any of the foregoing organisms (data not shown).

Considering that the spike of peritonitis presentations on Mondays raises the possibility that patients experiencing symptoms of peritonitis on the weekend might have been delaying presentation until normal PD clinic hours on Monday, the outcomes for Monday presentations

were compared with those for presentations on other days. No significant differences were observed between the groups with respect to cure rates (77% vs 79% respectively, $p = 0.4$). Hospitalization rates were lower on Mondays (67% vs 73%, $p = 0.002$), but all other outcomes were comparable (data not shown). Using multivariate logistic regression, Monday presentation was not associated with cure rate.

DISCUSSION

The present study, involving all patients receiving PD in Australia between 2003 and 2008, represents the only examination to date of the effects of weekend and weekday presentation on the occurrence, microbiology, treatment, and clinical outcomes of a dialysis complication. The key findings were that presentations with PD peritonitis were significantly less common on the weekend and were primarily influenced by patient proximity to their nearest PD unit and patient BMI (although the magnitude of the difference in BMI of patients presenting on the weekend and on a weekday was small). In spite of this temporal variation in presentation with peritonitis to a PD service, the microbiology, treatment, and outcomes of weekend and weekday PD peritonitis were remarkably similar, except that weekend presentations were associated with higher rates of antifungal prophylaxis prescription and hospitalization, but lower cure rates for culture-negative peritonitis episodes.

Reductions in the frequency of presentation to hospitals or other health services on weekends compared with weekdays have been reported for a variety of conditions (2–4) and have been argued to result from patients experiencing less severe forms of illness over the weekend, leading to a decision to defer presentation until the following Monday (4). In the present study, that suggestion was supported by the fact that presentations with peritonitis peaked on Mondays and then declined during the rest of the working week, falling dramatically on weekends (Figure 1). Unfortunately, ANZDATA does not record the duration of PD peritonitis symptoms before presentation to a hospital or renal unit, such that the hypothesis that patients presenting on Mondays had a longer duration of peritonitis symptoms than did those presenting on other days of the week could not be tested. The observation that patients living more than 100 km away from the unit were also less likely to present on a weekend raises the possibility that accessibility to a PD service was a key factor affecting the timeliness of presentation with PD peritonitis. Alternatively, it is also conceivable that the observed variations in peritonitis presentations throughout the week may have reflected

true differences in the propensities for patients to develop peritonitis. For example, the possibility that patients have more time to carefully perform their PD with fewer errors on the weekend cannot be excluded.

There was also no evidence to suggest that the severity of peritonitis varied according to the day of presentation, given that patients presenting with peritonitis on the weekend generally had microbiologic profiles, empiric antibiotic treatment regimens, and clinical outcomes similar to those in patients presenting on weekdays. There was a slightly but significantly higher frequency of presentations with streptococcal peritonitis on the weekend, for reasons that are unclear. It is possible that the foregoing finding may reflect a type 1 statistical error (random chance) in view of the large number of comparisons made between weekend and weekday presentations for a multitude of organisms.

In keeping with the findings of our group's previous studies (5–16), co-prescription of antifungal prophylaxis for peritonitis episodes was generally low. However, such prescription was significantly more likely to occur with weekend presentations than with weekday presentations. This difference may have reflected the higher hospitalization rates with weekend presentations and an increased compliance with hospital protocols when patients were admitted. Indeed, patients with peritonitis who were not hospitalized were significantly less likely to be prescribed antifungal prophylaxis. However, after adjustment for that variable, weekday presentation was still independently associated with a lower probability of antifungal prophylaxis prescription.

When clinical outcomes were examined on either univariate or multivariate analysis, no significant differences between weekend and weekday peritonitis were observed with respect to antimicrobial cure, relapse, catheter removal, hemodialysis transfer, or death. Although some of the excess peritonitis presentations on Mondays may have represented delayed presentations of patients with weekend onset of symptoms, no adverse impacts on clinical outcomes were demonstrated. These findings might potentially be explained by the fact that most Monday episodes did not reflect delayed weekend peritonitis presentations at all, or that the magnitude of the delays did not appreciably influence outcomes, or that episodes with presentation delayed until Monday were relatively mild in severity. Importantly, compared with patients presenting with PD peritonitis on weekdays, patients presenting on the weekend were significantly more likely to be admitted to hospital, thereby leading to increased treatment costs. That finding may have reflected a lack of available experienced staff on the weekends, leading to a decision to err on the side of

caution and admit a patient who might have otherwise have been able to be treated as an outpatient if the initial presentation had been on a weekday. Alternatively, it may have reflected a lack of availability of weekend services that could accommodate outpatient management of PD peritonitis. Both of those possibilities are supported by the observation that patients admitted on the weekend spent a shorter time in hospital than did those admitted on a weekday. This shorter hospital stay in weekend presentations and the observation of similar treatment approaches and outcomes compared with weekday presentations argue against heightened admission rates for peritonitis on the weekend because of increased clinical severity.

When subgroup analyses were performed in patients according to peritonitis microbiology, weekend presentations with a first episode of culture-negative peritonitis were associated with a significantly lower cure rate because of higher rates of catheter removal and permanent transfer to hemodialysis. The reasons for those observations are uncertain, given that the slightly lower rate of culture-negative peritonitis in weekend presentations would argue against initial dialysate sampling difficulties by inexperienced after-hours staff leading to impaired microbial identification and appropriate treatment. For all other organisms examined, no differences were observed in the rates of cure, catheter removal, hemodialysis transfer, or death between weekend and weekday peritonitis presentations. Those findings suggest that peritonitis microbiology did not generally modify the relationship between day of presentation and clinical outcomes.

The strengths of our study include its very large sample size and inclusiveness. We included all patients receiving PD in Australia during the study period, such that a variety of centers with varying approaches to the microbiologic diagnosis and treatment of peritonitis were included. The inclusiveness greatly enhanced the external validity of our findings. Those strengths should be balanced against the study's limitations, the principal limitation being selection bias because of the nonrandom nature of day of presentation with PD peritonitis. We adjusted for a large number of patient characteristics, but the possibility of residual confounding cannot be excluded. Moreover, registry studies are necessarily constrained by limited depth of data collection. ANZDATA does not collect important information such as the duration of peritonitis symptoms before presentation, presence of concomitant exit-site and tunnel infections, antimicrobial susceptibilities of isolated micro-organisms, patient compliance, mobility, educational background, socio-economic status, ability to drive, access to transport, living circumstances,

individual unit management protocols, duration of cloudy dialysate, laboratory values such as C-reactive protein and dialysate white cell counts, severity of comorbidities, PD modality (automated or continuous ambulatory PD) at time of peritonitis, disconnect systems used, prescribed PD dialysate (especially icodextrin), antibiotic dosages or routes of antibiotic administration, peritoneal dialysate culture methodology, or previous antibiotic exposure for any indication. In common with other registries, ANZDATA is voluntary, and no external audit of data accuracy, including the diagnosis of peritonitis, are performed. Consequently, the possibility of coding or classification bias, including differential data capture throughout the week, cannot be excluded.

CONCLUSIONS

Our national study represents the first examination to date of the effects of weekend compared with weekday presentation on the occurrence, microbiology, treatment, and clinical outcomes of PD-associated peritonitis. The findings that PD patients with peritonitis were less likely to present on the weekends and more likely to present on Monday has significant implications for PD service planning with respect to ensuring the continuous availability of, and patient access to, staff experienced in managing PD peritonitis. The variable use of antifungal prophylaxis according to day of presentation and whether the patient has been hospitalized also warrant reviews of protocol adherence in the ambulatory and after-hours setting. Nevertheless, the generally comparable clinical outcomes for weekend compared with weekday peritonitis are reassuring.

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DISCLOSURES

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