

Midline Catheter Administration of Antibiotics

Approved by Allina ID Task Force 5/9/2017

Generic Name	Yes	Usually	Maybe ^a	No	Phlebitis Risk ^{1,2}	Comments
Acyclovir				x	High	Irritant
Amikacin	x				Not Rated	once daily dosing
Ampicillin		x			Medium	limited stability; difficult to use outpatient
Ampicillin-sulbactam		x			Medium	
Azithromycin		x			Not Rated	
Cefazolin	x				Low	stable > 24hrs; syringe and electronic infusion pump compatible
Cefepime		x			Low	stable > 24hrs; syringe and electronic infusion pump compatible
Cefotaxime	x				Not Rated	
Cefoxitin	x				Not Rated	
Ceftazidime	x				Low	stable > 24hrs; syringe and electronic infusion pump compatible
Ceftriaxone	x				Low	once daily dosing
Cefuroxime	x				Low	
Ciprofloxacin			x		Not Rated	
Clindamycin	x				Low	stable > 24hrs; syringe and electronic infusion pump compatible
Daptomycin*		x*			Low	once daily dosing, pH is low but low phlebitis, manuf ok's midline
Doxycycline			x		Medium	once daily dosing; need to protect from sunlight
Ertapenem		x			Medium	Hateley C et al Lancet 2016;387:284. given via midline x5 weeks
Erythromycin				x	High	
Gentamicin			x		Low	once daily dosing
Imipenem-cilastatin		x			Medium	limited stability; difficult to use outpatient
Levofloxacin			x		Not Rated	
Meropenem		x			Low	limited stability; difficult to use outpatient
Nafcillin ^b				x ^b	High	stable > 24hrs; syringe and electronic infusion pump compatible
Oxacillin ^b				x ^b	Medium	stable > 24hrs; syringe and electronic infusion pump compatible
Penicillin G ^{*b}		x ^{*,b}			Medium	stable > 24hrs; syringe and electronic infusion pump compatible
Piperacillin-tazobactam		x ^d			Not Rated	stable > 24hrs; syringe and electronic infusion pump compatible
Sulfa-Trimethoprim				x	Medium	
Tobramycin			x		Low	once daily dosing
Vancomycin ^b				x ^{c,e}	Medium	once daily dosing possible

Usually: ≤14 days acceptable; individual home infusion policies may vary - need to confirm before discharge; assess phlebitis risk if friable veins

Maybe: ≤7 days recommended; some home infusion companies will not allow - need to confirm before discharge; not recommended if friable veins

No: Generally not recommended and home infusion companies often refuse; certain exceptions exist (see footnotes)

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*PICC preferred if > 7 days in some references

^aMaybe = sources are conflicting or information is sparse, <7-14 days likely acceptable but have some risk of irritation to veins; need to assess benefit/risk to patient

^bTypically prepared at a concentration not amenable to long-term peripheral or midline administration, but concentration may be adjusted

^cSeveral studies have found that peripherally infused vancomycin causes no more phlebitis than other antibiotics (Lanbeck P. *Scan J Infect Dis.* 2002; Mowry JL et al. *West J Nurs Res* 2010; Roszell S et al *J Infus Nurs.* 2010).

^dPip/tazo underwent a reformulation to resolve some issues including pH. However, the pH can be variable depending on manufacturer and can be as low as 3.2 (Desi NR, et al. *Ther Clin Risk Manag* 2008 Apr;4(2):303-314)

^eConcentrations of 5 mg/mL are usually acceptable, but typically prepared at 10 mg/mL. Need to ensure proper preparation and home infusion willingness

¹ Degree of tendency to cause phlebitis; 1, mild; 2, moderate; 3, high; NR, not rated. (Paladino JA, Portez D. Outpatient Parenteral Antimicrobial Therapy Today. *Clin Infect Dis*

(2010) 51 (Supplement_2):S198-S208.)

²The 2016 Infusion Nurses Society Standards recommend cautious use of noncontinuous (or intermittent) vesicant antimicrobial administration because there is the risk of undetected extravasation due to the deeper vein placement.

Antibiotics and Midline Catheters

Approved by the Allina ID Task Force 5/9/2017

Evidence Summary

- There are no specific guidelines regarding which antibiotics are, or are not to be given via a midline catheter, and recommendations in the literature are conflicting
- **Almost all antibiotics can be administered via a midline or peripheral line short-term**; long-term use increases the risk of undetected extravasation due to deeper vein placement
- The following recommendations are nonspecific drug recommendations from various authorities
 - Do NOT use midline catheters for continuous vesicant therapy, parenteral nutrition, or infusates with an osmolarity greater than 900 mOsm/L
 - DO use midlines for drugs with **pH 5-9** (near plasma level) or **osmolarity < 500 mOsm**
 - pH theory has come into question by some given that drugs like erythromycin (pH 6.5-7.5) cause far more phlebitis than drugs such as vancomycin
 - Avoid use of midline catheters when patient has a history of thrombosis, hypercoagulability, decreased venous flow to the extremities, or ESRD requiring vein preservation (Infusion Nurses Society)
- When comparing PICCs vs Midlines:

PICC	Midline
<ul style="list-style-type: none"> • BSI rate: 2.79 – 4.79 per 1000 catheter days <ul style="list-style-type: none"> ○ Public reporting required • DVT rate: 1 – 38.5% symptomatic; 27.2% asymptomatic • Tip dislocation rate: 15.4% (usually to neck) • Last 7.3 – 16.6 days <ul style="list-style-type: none"> ○ Complete 71 - 87% of intended therapy • More expensive 	<ul style="list-style-type: none"> • BSI rate: 0.2 per 1000 catheter days (homecare rate of 0.9/1000 catheter days) <ul style="list-style-type: none"> ○ Public reporting not required • DVT rate: <2% • Last 7.69 - 16.4 days <ul style="list-style-type: none"> ○ Complete 79 – 89% of intended therapy • Less expensive

- Overall, midline catheters are associated with lower rates of phlebitis than short peripheral catheters and lower rates of infection compared to central venous catheters
 - In one prospective study of 140 midline catheters:
 - No specific risk factors, including duration of catheterization, were associated with infection.
 - Midlines were in place a median of 7 days, and as long as 49 days
- Duration: Typical maximum dwell time is 2 to 4 weeks. If therapy is to extend beyond 4 weeks, a PICC is commonly placed, but replacing the midline catheter instead can be considered.
- Blood draws are not recommended via midlines, and blood draws are strongly discouraged via PICC lines. (Note: Drug levels are not recommended via PICC.)

Table 1. Selected evidence summary for midline catheters

Study	Population	Intervention	Outcome	Comments
Caparas et al (2014) ³	Patients (n=54) randomized to midline device or PICC to receive vancomycin (<6 days, but greater than 1 dose)	<ul style="list-style-type: none"> • Vancomycin 4 mg/mL administered over at least 60 minutes by infusion pump • 29 patients received IV vancomycin for >5 days 	<ul style="list-style-type: none"> • No cases of phlebitis or thrombosis • Complications 17.9% vs 19.9% for PICCs vs midlines • Midlines: 1 “leak”, 2 dislodgements, 3 Grade I infiltrations • PICCs: 1 suspected BSI, 4 dislodgements 	No CLABSIs, thrombosis, phlebitis noted with midline catheter.
Harwood et al (1992)	Outpatients (n=27) with cystic fibrosis Mean age: 22 Mean weight: 109 lb	<ul style="list-style-type: none"> • 2 week courses of antibiotics • >95% received tobramycin (150 mg/100 mL D5W) or ceftazidime (3 g/100 mL D5W) 	<ul style="list-style-type: none"> • Midline dwell times: 0.2-48 days, average 12 days • Almost 60% of midlines reached end of therapy 	Phlebitis rates published for PICCs and short peripheral catheters at 7 days are 20% and >51%, respectively

Study	Population	Intervention	Outcome	Comments
		<ul style="list-style-type: none"> 41 midlines in 27 patients 	<ul style="list-style-type: none"> 80% of midline cath removals were for non-catheter related reasons No cases of phlebitis 	
Fontaine et al (1991)	Pilot study (n=43) of homecare patients with osteomyelitis (32%) and infections on antibiotics	<ul style="list-style-type: none"> 58 midlines in 43 patients - 31 patients had one insertion - 9 patients had two insertions - 3 patients received three insertions 70% were inserted in cephalic vein, 30% were basilic <p>76% of infusions were IV antibiotics; 92% of all infusions had the side effect of "phlebitis" listed by manufacturer</p>	<ul style="list-style-type: none"> Median time to complication was 16 days (one half the midline catheters would have dwelled for 16 days if they were removed for catheter complications). Patients in this study had a history of catheter restarts every 2.7 days with peripheral catheters. Reasons for removal 	<p>14 midline catheters were removed for phlebitis (average time to occurrence = 8 days)</p> <p>7 cases of phlebitis were thought to be chemical. Three patients had infusions of nafcillin 2g/100 mL q4h and penicillin VK 2 million units in 50 or 100 mL NS q4h. Phlebitis occurred within 2 hours to 1 week post infusion. Medications were diluted further which improved dwell times.</p>

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Infusion Drug List: pH, Osmolality, reported phlebitis

Drug	Diluent	pH	mOsmol/L	Phlebitis*
Acyclovir	NS @ 5mg/ml	10.5-11.6	316	yes
Amikacin	NS @ 5mg/ml	3.5-5.5	349	
Aminophylline	NS @ 5mg/ml	8.6 - 9	327	
Amiodarone	D5W @ 2mg/ml	4.1		yes
Amphotericin B	D5W @ 0.1mg/ml	5.7	256	yes
Amphotericin B Albecet	D5W @ 1-2mg/ml	5.5 - 6	~280	yes
Amphotericin B Ambisome	D5W @ 1-2mg/ml	5 - 6	~280	yes
Amphotericin B Amphotec	D5W @ 0.2-0.8mg/ml	5 - 6	~280	yes
Ampicillin - Sulbactam	NS 100ml	9 (8 - 10)	~400	yes
Ampicillin 1 & 2 gm	NS 100ml	9 (8 - 10)	328 - 372	
Amrinone	NS @ 2.5mg/ml	3.2 - 4	~300	yes
Azithromycin 500 mg	NS @ 2mg/ml	6.4 - 6.8	~280	yes
Aztreonam 1 gm	SWI 10ml	6 (4.5-7.5)		
Aztreonam 1 - 2 gm	NS 100 ml	6 (4.5-7.5)	315-352	
Aztreonam 1- 2 gm Frozen	Dextrose 50ml	5.0 - 5.6	270 - 330	
Bleomycin	NS@3units/ml	4.5 - 6	~300	
Carboplatin	D5W 0.2 - 2 mg/ml	5 - 7	~250	
Carmustine	D5W 250 - 500ml	5.6 - 6		
Caspofungin	NS @ 0.28-0.35 mg/ml	6.6		yes
Cefamandole 1 gm	SWI 10 ml	6-8.5	466	
Cefamandole 1 gm	NS 100ml	7 (6-8.5)	314	
Cefazolin 1 - 2 gm	SWI 10 ml	4.5-7	293	
Cefazolin 1 - 2 gm	NS 100 ml	4.5-7	317 - 351	
Cefazolin 1 gm Frozen	Dextrose 50ml	5.4 - 6.4	270 - 330	
Cefazolin 500mg Frozen	Dextrose 50ml	5.4 - 6.4	270 - 330	
Cefepime 1 - 2 gm	NS 100 ml	4 - 6	307	
Cefmetazole 2gm	NS 100 ml	4.2 - 6.2	317	
Cefoperazone 1 gm	SWI 10ml	5 (4.5-6.5)	290	
Cefoperazone 1 gm	NS 100ml	5 (4.5-6.5)	307	
Cefoperazone 1gm Frozen	Dextrose 50ml	5.3 - 5.8	276 - 324	
Cefoperazone 2 gm Frozen	Dextrose 50ml	5.3 - 5.8	276 - 324	
Cefotaxime 1 - 2 gm	NS 100 ml	5-7.5	344 - 351	
Cefotaxime 1 gm	SWFI 10 ml	5-7.5	357	
Cefotaxime 1- 2 gm Frozen	Dextrose 50ml	6.2 - 6.8	270 - 330	
Cefotetan 1 gm	NS 100 ml	4.5-6.5	~380	
Cefotetan 2 gm	NS 100 ml	4.5-6.5	~420	
Cefotetan 1- 2 gm Frozen	Dextrose 50ml	5.0 - 6.4	270 - 330	
Cefotetan 1 gm	SWI 10 ml	4.5-6.5	400	
Cefoxitin 1 - 2 gm	NS 100 ml	4.2-8	319 - 355	
Cefoxitin 1 gm	SWI 10 ml	4.2-8	390	
Cefoxitin 1- 2 gm Frozen	Dextrose 50ml	5.9 - 6.6	270 - 330	
Ceftazidime 1 gm	SWI 10 ml	5.5 - 8	240	
Ceftazidime 1 gm Frozen	Dextrose 50ml	5.4 - 6.0	270 - 330	
Ceftazidime 1-2 gm	NS 100 ml	5.5 - 8	330	
Ceftazidime 2 gm	SWI 20 ml	5.5 - 8	240	
Ceftazidime 2 gm Frozen	Dextrose 50ml	5.4 - 6.0	270 - 330	
Ceftizoxime 1 gm	SWI 10 ml	5.5-8	350	
Ceftizoxime 1 gm	NS 100ml	6 - 8	320	
Ceftizoxime 1-2 gm Frozen	Dextrose 50ml	6.7 - 8.0	270 - 330	
Ceftriaxone 1 - 2 gm	NS 100 ml	6.6-6.7	350	
Ceftriaxone 1 gm	SWI 10 ml	6.6-6.7	423	
Ceftriaxone 1-2gm Frozen	Dextrose 50ml	6.2 - 6.9	270 - 330	
Cefuroxime 0.75 - 1.5g	NS 100 ml	6-8.5	~300	
Cefuroxime 1.5 gm Frozen	Dextrose 50ml	5.2 - 5.8	270 - 330	
Cefuroxime 1gm	SWI 10ml	6-8.5	357	

Drug	Diluent	pH	mOsmol/L	Phlebitis*
Cefuroxime 750mg Frozen	Dextrose 50ml	5.2 - 5.8	270 - 330	
Chloramphenicol 1 gm	SWI 10 ml	6.4-7	344	
Chloramphenicol 1 gm	NS 100 ml	6.4-7	330	
Cidofovir	NS 100ml	7.4	~300	
Cimetidine	NS 50ml	3.8 - 6	314	
Ciprofloxacin 200 mg	D5W 100 ml	3.3-4.6	285	yes
Ciprofloxacin 400 mg	D5W 200 ml	3.3-4.6	285	yes
Cisplatin	NS 0.05 - 2mg/ml	3.5 - 6	~300	
Cladribine	NS 500 ml	5.7 - 8	~300	yes
Clindamycin 600 mg	NS 100 ml	6.3 (5.5-7)	294	
Clindamycin 900 mg	NS 100 ml	6.3 (5.5-7)	294	
Cyclophosphamide	NS 250ml	6.9 (3 - 7.5)	~300	
Cytarabine	NS @ 100mg/ml	5 (4-6)	~300	
Dacarbazine	10mg/ml SWI	3 - 4	109	
Dacarbazine	NS 250 ml	3 - 4	~300	
Daclizumab 5mg/ml	NS 50 ml	6.9	~300	
Dactinomycin	SW 0.5 mg/ml	5.5 - 7	189	
Dactinomycin	NS or D5W 50 ml	5.5 - 7	~300	
Daunorubicin HCl	NS 15ml	4.5 - 6.5	~300	
Daunorubicin HCl	NS 100ml	4.5 - 6.5	~300	
Deferoxamine	SW @ 250mg/ml	4 - 6		
Dexrazoxane	NS @ 5mg/ml	3.5 - 5.5		yes
Dextrose 10%	NA	4.0 (3 - 6.5)	505	
Dextrose 5%	NA	4.0 (3 - 6.5)	252	
Dextrose 5% Sod Cl 0.45%	NA	4.0 (3 - 6.5)	406	
Dextrose 5% Sod Cl 0.45%+KCl 20mEq	NA	4.0 (3 - 6.5)	447	
Dextrose 5% Sod Cl 0.45%+KCl 40mEq	NA	4.0 (3 - 6.5)	487	
Dextrose 5% Sod Cl 0.9%	NA	4.0 (3 - 6.5)	560	
Dobutamine HCL	NS @ 4mg/ml	3.5 (2.5-5.5)	280	yes
Docetaxel	NS 0.3-0.9mg/ml			yes
Dolasetron	SW @ 20mg/ml	3.2 - 3.8	285	yes
Dopamine HCL	D5W	3.3(2.5-4.5)	277	yes
Doxorubicin	SW 2 mg/ml	2.5 - 4.5	280	
Doxorubicin	NS @ 2 mg/ml	3.8 - 6.5		
Doxorubicin HCL Liposome	D5W 250ml	6.5		
Doxycycline 100mg-200mg	NS @ 1mg/ml	1.8-3.3	310	
Enalaprilat	D5W 50ml	6.5 - 7.5		
Epirubicin - Ellence	SW 2mg/ml	3.0		
Epirubicin - Pharmorubicin	SW 2mg/ml	4 - 5.5		
Erythromycin 500 mg	NS 100 ml	7(6.5 - 7.7)	291	yes
Erythromycin 1 gm	NS 250 ml	7(6.5 - 7.7)	290	yes
Etoposide	NS 0.2-0.4 mg/ml	3 - 4		yes
Etoposide phosphate	NS 10mg/ml	3 - 4	~290	yes
Famotidine	NS 50ml	5 - 5.6	290	
Floxuridine	NS @ 10mg/ml	4 - 5.5	355	
Fluconazole 100 mg	NS 50 ml	4 - 8	315	
Fluconazole 200 mg	NS 100 ml	4 - 8	315	
Fludarabine	NS 100ml	7.2 - 8.2	352	
Fluorouracil	SW @ 50mg/ml	9.2	650	
Foscarnet	SW @ 24mg/ml	7.4	271	yes
Fosphenytoin	NS @1.5-25PE/ml	8.6 - 9		yes
Ganciclovir < 500 mg	NS 100 ml	11.0	320	yes
Gatifloxacin	D5W 10mg/ml	3.5 - 5.5		yes
Gemcitabine	NS 40mg/ml	2.7- 3.3		
Gentamicin 100 - 250 mg	NS 100 ml	3-5.5	280 - 290	

Drug	Diluent	pH	mOsmol/L	Phlebitis*
Granisetron	SW 1mg/ml	4.7 - 7.3	290	
Hemin for injection	SW @ 7mg/ml	8 - 9.5	~300	yes
Heparin sodium	NS 1000 units/ml	5 - 8	283-384	
Heparin sodium (Premix D5)	25,000 u /250 ml	5.5 (5 - 6)	298	
Heparin sodium (Premix NS)	25,000 u /250 /ml	7 (6 – 8)	322	
Hydrocortisone	SW @ 50mg/ml	7 - 8	360	
Hydromorphone	SW 10mg/ml	4 - 5.5	~333	
Idarubicin	1 mg/ml	3.5		
Ifosfamide	NS@0.6-20mg/ml	6		
Imiglucerase	NS 20 units/ml	6.1		
Imipenem/cilastatin	NS @ 5mg/ml	6.5-7.5	310	yes
Infliximab	NS@0.4-4mg/ml	7.2	~300	
Intravenous immunoglobulins	3% to 12%	4 - 7.2	~300	
Irinotecan	D5W @ 0.12-1.1mg/ml	3 -3.8		
Iron Dextran Intravenous	NS @ 50mg/ml	5.2 - 6.5	2000	yes
Iron Dextran Intravenous	NS @ 0.1mg/ml	5.2 - 6.5		yes
Itraconazole	NS 3.3mg/ml	4.8		yes
Leucovorin	SW 10mg/ml	8.1	274	
Levofloxacin 250 mg	D5W 50 ml	3.8-5.8	~250	yes
Levofloxacin 500 mg	D5W 100 ml	3.8-5.8	~250	yes
Linezolid	Dextrose 2mg/ml	4.8	290	
Meperidine	SW 50mg/ml	3.5 - 6	302	
Meropenem	NS @ 5mg/ml	7.3 - 8.3	~300	yes
Methicillin 1 gm	SWI 10 ml	7.6 (6-8.5)	510	yes
Methicillin 2- 3 gm	100 ml NS	7.6 (6-8.5)	371 - 415	yes
Methotrexate	SW @ 25 mg/ml	8.5	~300	
Methylprednisolone 500 mg	D5W100 ml	7 - 8	301	
Methylprednisolone 1 gm	D5W 250ml	7 - 8	319	
Metoclopramide	SW @ 5mg/ml	4.5 - 6.5	280	
Metoclopramide	NS @ 1.25mg/ml	4.4	285	
Metronidazole	NS @ 5mg/ml	5 - 7	310	
Milrinone	D5W 200mcg/ml	3.2 - 4		
Minocycline	NS@0.1-0.2mg/ml	2 - 2.8	~300	
Mitomycin	SW @ 0.5mg/ml	6 - 8	9	
Mitoxantrone	NS @ 0.2mg/ml	3 - 4.5	~300	yes
Morphine Sulfate	NS 10mg/ml	4 (2.5-6.0)	295	yes
Nafcillin 1 - 3 gm	NS 100 ml	6-8.5	361 - 398	yes
Nafcillin 1-2 gm Frozen	Dextrose 50ml	6.7 - 7.2	276 - 324	yes
Nicardipine	NS @ 0.1mg/ml	3.5	~300	
Octreotide	SW @0.5mg/ml	3.9 - 4.5	279	
Ofloxacin	D5W @ 4mg/ml	3.8 - 5.8	252	
Ondansetron	D5W 32mg/50ml	3.3 - 4	270	
Oxacillin 1 gm	SWI 10 ml	6-8.5	398	yes
Oxacillin 1 - 2 gm	NS 100 ml	6-8.5	321 - 356	yes
Oxacillin 1- 2 gm Frozen	Dextrose 50ml	6.8 - 7.2	270 - 324	yes
Paclitaxel	D5W @ 0.3-1.2 mg/ml	4.4 - 6.5		
Pamidronate	NS @ 0.09mg/ml	6 - 7.4	~300	yes
Pantoprazole 40mg	NS 100ml	9.0-10.0	295	
Parenteral Nutrition	Amino acids-dextrose-fat	5.5	>600	yes
Parenteral Nutrition	Amino acids-dextrose	5.3 - 6.3	>800	yes
Penicillin GK 1-3 MU Frozen	Dextrose 50ml	6.8 - 7.2	276 - 324	
Penicillin GK or Na	NS @ 50units/ml	7 (6-8.5)	420	
Pentamidine IVPB	D5W @ < 3mg/ml	4 - 4.4	455	yes
Phenytoin	NS @ 5mg/ml	12	312	yes
Piperacillin	SWI @ 163mg/ml	5.5-7.5	439	

Drug	Diluent	pH	mOsmol/L	Phlebitis*
Piperacillin	NS @ 40mg/ml	5.5-7.5	404	
Piperacillin/tazobactam 2.25-4.5gm Frozn	Dextrose 50ml	6.2 - 6.7	270 - 330	
Piperacillin/tazobactam 3.375 gm	NS 100 ml	5.1-5.4	445	
Plicamycin	NS 1000ml	7.0	~300	
Potassium chloride premix	0.4 mEq/ml	5.0	800	yes
Potassium chloride premix	0.3 mEq/ml	5.0	600	yes
Potassium chloride premix	0.2 mEq/ml	5.0	400	
Potassium chloride premix	0.1 mEq/ml	5.0	200	
Quinupristin-dalfopristin	D5W @ 2mg/ml	4.5 - 5		yes
Ranitidine 50mg	NS 50ml	6.7 - 7.3	302	
Rifampin < 600 mg	D5W 100 ml	7.8-8.8		
Rituximab	NS or D5W 1 - 4 mg/ml	6.5		
Sargramostim	NS @ 10mcg/ml	7.1 - 7.7	~300	
Sodium Chloride 0.45%	NA	5.0 (4.5 – 7.0)	154	
Sodium Chloride 0.9%	NA	5.0 (4.5 – 7.0)	308	
Streptozosin	D5W 100mg/ml	3.5 - 4.5		
Sulfamethoxazole/Trimethoprim 80&400/5ml	D5W 100ml	10	541	yes
Teniposide	NS @ 0.4mg/ml	5 (4 - 6.5)		
Thiotepa	NS @ 1mg/ml	5.5 - 7.5	269	
Ticarcillin 3 gm	NS 100 ml	6 - 8	442	
Ticarcillin/clavulanate 3.1gm	SW @ 86mg/ml	6 - 8	573	
Ticarcillin/clavulanate 3.1gm	NS 100 ml	5.5-7.5	450	
Ticarcillin/clavulanate 3.1gm Frozen	Dextrose 50ml	6.8 - 7.2	265 - 305	
Tobramycin 100 - 250 mg	NS 100 ml	3-6.5	290	
Topotecan	D5W 50ml	2.5 - 3.5		
Trastuzumab	NS 250 ml	6	~300	
Trimetrexate	D5W@ 0.25-2mg/ml	3.5 - 5.5		
Vancomycin 1.5 gm	NS 250 ml	2.5-4.5	~300	
Vancomycin 1-1.25gm	NS 250 ml	2.5-4.5	290	
Vancomycin 500mg	NS 100 ml	2.5-4.5	291	
Vancomycin 1 gm Frozen	Dextrose 200ml	3.5 - 4.3	266 - 302	
Vancomycin 500mg Frozen	Dextrose 100ml	3.5 - 4.3	266 - 302	
Vinblastine	NS 1mg/ml	3.5 - 5	278	
Vincristine	SW 1mg/ml	3.5 - 5.5	610	
Vindesine	NS 1mg/ml	4.2 - 4.5		
Vinorelbine	D5W@1.5-3mg/ml	3.5		yes
Zidovudine	D5W @ 4mg/ml	5.5	~260	yes
*Phlebitis means the drug produces phlebitis when the pH and osmolarity are acceptable				
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