

「臺灣居家感染症注射型經驗性抗生素建議」

The recommendations of empirical parenteral
antibiotics for infectious diseases out of hospital in
Taiwan, 2024

2024/06/06 ver 1.0

壹、前言：

本治療建議係由臺灣感染症醫學會（The Infectious Diseases Society of Taiwan, IDST）、臺灣急診醫學會（Taiwan Society of Emergency Medicine）、臺灣家庭醫學醫學會（Taiwan Association of Family Medicine）、臺灣在宅醫療學會（Taiwan Society of Home Health Care）、及中華民國藥師公會全國聯合會（Federation of Taiwan Pharmacists Associations）等諸位專家，參照現行醫療常規、國內外相關治療指引、澳大利亞（Commonwealth of Australia）之 Hospital in the Home 施行經驗、以及臺灣地區年度抗生素抗藥性監測結果，透過文獻回顧、跨學會跨專業的討論，並且考量藥物特性、可近性、方便性，制定相關藥物建議，期許給予居家病人適切之治療。

由於病人的屬性多樣化及各地區醫療資源分佈之異質性，本治療建議僅供臨床團隊參考，無法取代第一線醫療團隊之專業評估。本文提及之抗生素主要以靜脈注射（Intravenous）為主，部分口服（Oral）抗生素因具有與靜脈注射抗生素相匹配之生物利用性（Bioavailability）或相近之抗菌譜，故本文亦予以保留，作為替代或抗生素降階之選擇；若因病人狀況，臨床團隊必須選擇皮下注射（Subcutaneous）及肌肉注射（Intramuscular）給藥途徑，建議與藥劑專家討論適合與否。總而言之，實際病人藥物選擇、途徑之選擇、療程之長短，仍應尊重當下臨床第一線醫療團隊之專業判斷、該地區醫療資源之可近性、病人之自主意願、病人情況之適切性、以及病人及家屬的共同決策（Shared decision making, SDM）。

由於感染症會依照不同病原菌而有不同表現、病程變化、嚴重度，故強烈建議第一線醫療團隊在情況允許時皆應盡可能留取相關病原菌培養或相關檢驗，並且依照相關結果及抗生素感受性調整適當用藥，以期達到抗生素之 5Ds 要點：正確診斷（diagnosis）、正確藥品（drug）、正確劑量（dosage）、正確期程（duration）、適時降階（de-escalating therapy）或升階治療（escalating therapy）。針對特定病原菌、感染症、或療程治療若有疑義，建議參考國內外各大感染症相關治療指引、或徵詢相關專家意見。

考量病況嚴重度、病人條件、治療複雜度，文中列有若干情形建議「留院治療」或「轉醫院治療」尤佳。倘若病人已進入末期階段，經醫療團隊充分說明與溝通後，病人與家屬瞭解醫療照護當以舒適為目標時，此臨床情境已超出本建議所能涵蓋之範疇，故不在文中詳述。

酌情院外注射型藥物之不便利性、醫護人員可近性、家屬或照護人員之技

術純熟等問題，以及臺灣地區日益漸增的細菌抗藥性，為避免無限制使用廣效性抗生素導致社區抗藥性菌株散佈，本治療建議採「窄效→廣效抗生素」、「口服藥物→靜脈注射→持續性 24 小時靜脈注射藥物」之順序編排，建議臨床人員參考順序選用適切之抗生素。除此之外，考量各醫療院所藥物單位劑量之不同，本文無論口服或靜脈注射藥物，統一以毫克（mg）作為呈現；若為複方藥物，則同時呈現兩成份總和毫克（mg）及內容成份毫克（mg）（例如 Piperacillin/Tazobactam (4000/500) 4500 mg）。

本文將隨著美國、臺灣、或國際上最新治療指引不定期更新，並依照臺灣地區最新年度抗生素抗藥性監測結果做調整。任何未竟完善之處，建議隨時徵詢感染症專家之意見。

註 1：感染症治療成功與否之關鍵在於適切之藥物選擇，在處方抗生素前強烈建議收集檢體執行微生物培養。

註 2：病人接受「居家感染症注射型抗生素」治療，需要各領域專家團隊之通力合作，包含醫師、護理人員、藥師等。部分藥物建議 24 小時輸注，建議與藥師確認稀釋溶液、稀釋體積、稀釋後濃度及滲透壓（Osm），並與護理同仁確認給藥幫浦及管路。處方抗生素有疑慮時，建議可諮詢感染科醫師意見，必要時可配合遠距醫療。

貳、重要名詞定義或名詞縮寫：

- 1 居家感染症注射型抗生素 (parenteral antibiotics for infectious diseases out of hospital)
 - 1.1 係指任何於醫院之外施行之注射抗生素治療，包含靜脈注射 (Intravenous, IV)、24 小時持續靜脈輸注 (24hr continuous infusion, 24hr cIF)、皮下注射 (Subcutaneous) 及肌肉注射 (Intramuscular)。本文內容以靜脈注射 (IV, 24hr cIF) 為主。
 - 1.2 24 小時持續靜脈輸注 (24hr cIF) 之藥物建議以國際期刊曾經報導之藥物為主，唯考量廠牌間產品之差異，使用前仍建議諮詢藥劑專家意見。
 - 1.3 24 小時持續靜脈輸注 (24hr cIF) 藥物採用幫浦或特製 Infuser，應以該醫療院所之設備量能為主。
- 2 肌酸酐廓清率 (Creatinine clearance, CCr or CrCl) by Cockcroft-Gault equation¹
 - 2.1 $[140 - \text{age (y)}] * \text{weight (kg)} / [\text{serum Cr (mg/dL)} * 72]$
 - 2.2 Multiply by 0.85 for women
- 3 「控制不佳之糖尿病」依照美國糖尿病協會 (American Diabetes Association, ADA) 之定義，係指糖化血色素 (HbA1c) 無法控制在 7.0 % 以下²。
- 4 「快速相繼器官衰竭評估 (quick Sequential Organ Failure Assessment, qSOFA)」評估項目如下：
 - 4.1 Consciousness alteration
 - 4.2 Respiratory rate > 22 breaths/min
 - 4.3 Systolic blood pressure $\leq$ 100 mmHg
- 5 「相繼器官衰竭評估 (Sequential [Sepsis-related] Organ Failure Assessment, SOFA)」評估項目包含：
 - 5.1 呼吸 (Respiration)， $\text{PaO}_2/\text{FiO}_2 < 400$
 - 5.2 凝血 (Coagulation)，Platelet count $< 150 \times 10^3/\mu\text{L}$
 - 5.3 肝臟 (Liver function)，Total bilirubin $\geq 1.2 \text{ mg/dL}$
 - 5.4 心臟血管 (Cardiovascular)，平均動脈壓 $< 70 \text{ mmHg}$
 - 5.5 腎臟 (Renal)，Creatinine $\geq 1.2 \text{ mg/dL}$
 - 5.6 中樞神經 (Central nervous system)，Glasgow coma scale < 15

- 6 「全身性發炎反應 (*Systemic inflammatory response syndrome, SIRS*)」定義如下³：
- 6.1 Temperature > 38 °C
 - 6.2 Heart rate > 90 beats/minute
 - 6.3 Respiratory rate > 20 breaths/minute
 - 6.4 White blood cell count > 12000 or < 4000 cells/ μ L
- 7 多重抗藥性微生物 (Multidrug-resistant organisms, *MDRO*) 係指下列細菌
- 7.1 Extended-spectrum β -lactamases-producing Enterobacterales (ESBL-E)
 - 7.2 AmpC β -lactamases-producing Enterobacterales (AmpC-E)
 - a. 常見如 *Enterobacter cloacae*, *Klebsiella aerogenes*, *Citrobacter freundii*⁴
 - 7.3 Carbapenem-resistant Enterobacterales (CRE)
 - a. Nonsusceptible to any kind of carbapenem (ertapenem, imipenem/cilastatin, meropenem, or doripenem)
 - 7.4 Carbapenemase-producing Enterobacterales (CPE)
 - a. Producing KPC, Oxa-48, IMP, VIM, NDM...etc
 - 7.5 Carbapenem-resistant *Acinetobacter baumannii* (CRAB)
 - a. Nonsusceptible to any kind of carbapenem (imipenem/cilastatin, meropenem, or doripenem)
 - 7.6 Carbapenem-resistant *Pseudomonas aeruginosa* (CRPA)
 - a. Nonsusceptible to any kind carbapenem (imipenem/cilastatin, meropenem, or doripenem)
 - 7.7 Vancomycin-resistant Enterococci (VRE)
 - a. Nonsusceptible to either vancomycin or teicoplanin
 - 7.8 Vancomycin-intermediate *Staphylococcus aureus* (VISA)
 - a. Vancomycin 最小抑菌濃度 (Minimal inhibitory concentration, MIC) = 4-8 mg/L or Teicoplanin MIC = 16 mg/L
 - 7.9 Vancomycin-resistant *Staphylococcus aureus* (VRSA)
 - a. VRSA = Vancomycin MIC $\geq$ 16 mg/L or Teicoplanin MIC $\geq$ 32 mg/L

參、肺炎 (Pneumonia)

1 肺炎之診斷，應具備以下條件⁵

- 1.1 病人具有急性下呼吸道症狀，包括咳嗽或至少下列一項症狀：有（膿）痰、氣促、喘鳴、胸部不適或胸痛。
- 1.2 不論有無胸腔影像設備的狀況，需具備以下條件：
 - a. 新的胸腔病徵，如：聽診之異常（支氣管音，加上/或是局部囉音）、叩診之異常（濁音、實音）等等。
 - b. 至少一項系統性病徵，如：發燒（大於攝氏 38 度）、出汗、寒顫、或其他非特異性症狀（頭痛、肌肉痠痛、食慾差、疲倦等）。
 - c. 症狀非導因於其他之診斷，如：氣喘、鼻竇炎。
- 1.3 在有胸腔影像設備的狀況（胸部 X 光或胸部電腦斷層），需具備以下條件：
 - a. 新出現或進展之肺浸潤。
 - b. 此影像學表現非因其他懷疑之診斷，如：肺水腫、肺栓塞。

2 肺炎分類 (Classifications of pneumonia)⁵

2.1 院內型肺炎 (Hospital-acquired pneumonia, HAP)

- a. 住院 48 小時以後，或距上次住院結束後 14 天內發生之肺炎。
- b. 需考慮病人之共病、住院過程、當地常見菌種及可能之抗藥性。

2.2 健康照護相關肺炎 (Healthcare-associated pneumonia, HCAP)

- a. 肺炎病人有下列情況者稱之：在 90 天內曾在急性病院住院大於二天以上者（但不符合出院 14 天內肺炎）、住在安養院或長期照護機構者、30 天內接受針劑抗生素、化學治療、傷口照護以及洗腎的病人。
- b. 其中，安養中心相關肺炎 (Nursing Home-associated pneumonia, NHAP)，由於有些住民只是單純因衰老需照顧而居住於機構內，但有些卻是長期臥病在床且需依賴長期管路維持生理機能，罹患肺炎之原因並不相同，菌種也未必相同。

2.3 社區型肺炎 (Community-acquired pneumonia, CAP)

- a. 病人不屬於上述兩種情形，在社區內發生之肺炎。

3 下述情況，通常建議「留院治療」或「轉醫院治療」尤佳。

3.1 病人屬於院內型肺炎 (HAP)

3.2 病人已知 90 天內痰液培養曾有多重抗藥性菌種 (MDRO)

- 3.3 病人免疫不全（包含器官移植病人、血液幹細胞移植病人、白血病等血液腫瘤疾病病人、無藥物控制之人類免疫缺乏病毒感染者、無脾臟或脾臟功能缺失、控制不佳之糖尿病...等）
- 3.4 病人在家生活無法自理、無人照料、或醫療依從性差
- 3.5 病人疾病嚴重度太高、生命徵象不穩定
 - a. 「qSOFA score」 ≥ 2 分 $\pm$ 「SOFA score」 ≥ 2 分
 - b. 「CRB-65」= 4 或 「CURB-65」= 4~5
- 4 健康照護相關肺炎（Healthcare-associated pneumonia, HCAP），需考量病人類型，是單純因衰老需照顧而居住於機構內，或是長期臥病在床且需依賴長期管路維持生理機能。^{5,6}
 - 4.1 若為單純衰老需照顧而居住於機構內，可採取社區型肺炎治療模式，依照下述 CRB-65 或 CURB-65 評估病人嚴重程度並給予適切之治療。（參照下述第 5 點）
 - 4.2 若為後者，此類病人常反覆進出醫療院所，感染抗藥性菌之風險有上升之可能，建議「留院治療」或「轉醫院治療」尤佳。若採機構內「靜脈注射型抗生素」治療，建議處方如下：
 - a. (24hr cIF) cefepime 6000 mg^{7,8} (7 days) 或
(24hr cIF) ceftazidime 6000 mg^{8,9} (7 days) 或
(24hr cIF) piperacillin/tazobactam (4000/500) 18000 mg^{8,10,11} (7 days)
並考慮合併下述用藥：
 - (1) Oral doxycycline 100 mg BID_{PC} (7 days) 或
Oral azithromycin 500 mg QD_{PC} (3 days)
 - (2) 若病人有吸入性肺炎之可能，cefepime 或 ceftazidime 療程期間建議合併 oral metronidazole 500 mg Q8H
 - b. (IV or oral) levofloxacin 750 mg QD_{AC1hr} (7 days)
 - 4.3 一般而言，治療 HCAP，療程參照 HAP，使用抗生素的時間約為一週，再根據臨床變化作調整及適度延長。
- 5 社區型肺炎（CAP）請依照 CRB-65 或 CURB-65 評估病人嚴重程度（如表 4），採取適當的治療措施。

表 5.1，CRB-65 及 CURB-65 診斷項目與嚴重度評估。

CRB-65	CURB-65	Point
Confusion		1
-	Blood urea nitrogen > 20 mg/dL	1
Respiratory rate $\geq$ 30 breaths/min		1
Systolic blood pressure < 90 mm Hg or diastolic blood pressure $\leq$ 60 mm Hg		1
Age $\geq$ 65 years		1

5.1 一般社區型肺炎的建議治療療程⁵

- 在輕至中嚴重度肺炎，抗生素療程 5~7 天為安全且有效。
- 在高嚴重度肺炎，抗生素療程 7 天為安全且有效。
- 若是病人一開始使用的抗生素是沒有效的、MRSA 引起之肺炎、或是其他較少見的致病菌引起之肺炎（如類鼻疽伯克氏菌或是黴菌），則可視菌種延長治療時間。

5.2 CRB-65 = 0~1 或 CURB-65 = 0~1，通常門診口服抗生素治療不需住院，常用藥物如同下列^{5,12}：

- Oral amoxicillin 1000 mg Q8H (5-7 days)
- Oral amoxicillin/clavulanate (875/125) 1000 mg BID_{PC} (5-7 days) 或
Oral amoxicillin/clavulanate (500/125) 625 mg TID_{PC} (5-7 days)
- Oral cefuroxime 500 mg Q12H (5-7 days)

5.3 CRB-65 = 0~1 或 CURB-65 = 0~1 且無法回診追蹤或共病不穩定（包含控制不佳之糖尿病、慢性心、肺、腎臟病變、惡性腫瘤、酗酒者、無脾臟或脾臟功能缺失¹²），可考慮下列居家口服或注射型抗生素治療^{5,12}。

- Oral cefuroxime 500 mg Q12H (7 days) 或
Oral amoxicillin/clavulanate (875/125) 1000 mg BID_{PC} (7 days)
並考慮合併下述用藥：
(1) Oral doxycycline 100 mg BID_{PC} (7 days) 或
Oral azithromycin 500 mg QD_{PC} (3 days)
- (IV or oral) moxifloxacin 400 mg QD_{AC1hr} (7 days) 或
(IV or oral) nemonoxacin 500 mg QD_{AC1hr} (7 days) 或
(IV or oral) levofloxacin 750 mg QD_{AC1hr} (7 days)
- (24hr cIF) penicillin G 18 MU¹³⁻¹⁵ (7 days) 或

(24hr cIF) cefuroxime 4500 mg¹⁶ (7 days)

並考慮合併下述用藥：

(1) Oral doxycycline 100 mg BID_{PC} (7 days) 或

Oral azithromycin 500 mg QD_{PC} (3 days)

5.4 CRB-65 = 2~3 或 CURB-65 = 2~3，若採取居家感染症注射型抗生素治療，建議藥物如下^{5,12}

a. IV ceftriaxone 2000 mg QD (7 days) 並合併下述用藥：

(1) Oral doxycycline 100 mg BID_{PC} (7 days) 或

Oral azithromycin 500 mg QD_{PC} (3 days)

b. IV moxifloxacin 400 mg QD (7 days) 或

IV nemonoxacin 500 mg QD (7 days) 或

IV levofloxacin 750 mg QD (7 days)

c. (24hr cIF) penicillin G 18 MU¹³⁻¹⁵ (7 days) 或

(24hr cIF) cefuroxime 4500 mg¹⁶ (7 days)

並合併下述用藥：

(1) Oral doxycycline 100 mg BID_{PC} (7 days) 或

Oral azithromycin 500 mg QD_{PC} (3 days)

5.5 CRB-65 = 4 或 CURB-65 = 4~5，通常急診病人建議「留院治療」、居家病人建議「轉醫院治療」，必要時需轉至加護病房治療。藥物選擇參照第 5.4 項或「台灣 2018 肺炎治療指引」。

6 社區型肺炎（CAP）且有吸入性肺炎（aspiration pneumonia）之情形，仍然依照前述 CRB-65 或 CURB-65 評估病人嚴重度，並額外考量口腔或消化道厭氧菌^{5,12}。

6.1 Oral amoxicillin/clavulanate (875/125) 1000 mg BID_{PC} (7 days) 或

Oral amoxicillin/clavulanate (500/125) 625 mg TID_{PC} (7 days)

6.2 Oral cefuroxime 500 mg Q12H 合併 oral metronidazole 500 mg Q8H (7 days)

6.3 (IV or oral) moxifloxacin 400 mg QD_{AC1hr} (7 days)

6.4 IV ceftriaxone 2000 mg QD 合併 oral metronidazole 500 mg Q8H (7 days)

6.5 (24hr cIF) cefuroxime 4500 mg¹⁶ 合併 oral metronidazole 500 mg Q8H (7 days)

肆、泌尿道感染（Urinary tract infection, UTI）

1 泌尿道感染之分類（Classifications of UTI）

1.1 非複雜型泌尿道感染（Uncomplicated UTI）^{17,18}

- a. Acute, sporadic or recurrent lower (uncomplicated cystitis) and/or upper (uncomplicated pyelonephritis) UTI, limited to non-pregnant women with no known relevant anatomical and functional abnormalities within the urinary tract or comorbidities, such as diabetes, an immunocompromised state, or recent urologic surgery.

1.2 複雜型泌尿道感染（Complicated UTI）^{17,19}

- a. All UTIs which are not defined as uncomplicated.
- b. Meaning in a narrower sense UTIs in a patient with an increased chance of a complicated course.（表 1.2）

表 1.2，複雜性泌尿道感染之常見因子。

Common factors associated with complicated UTIs ¹⁷	
Obstruction at any site in the urinary tract	UTI in males
Foreign body	Pregnancy
Incomplete voiding	Diabetes mellitus
Vesicoureteral reflux	Immunosuppression
Recent history of instrumentation	Healthcare-associated infections
Isolated ESBL-producing organisms	Isolated multi-drug resistant organisms

1.3 Catheter-associated asymptomatic bacteriuria（CA-ABU）

1.4 Catheter-associated urinary tract infection（CA-UTI）

1.5 Urosepsis

- a. Urinary tract infection with organ dysfunction, an increase in the SOFA score or qSOFA score of 2 points or more.

2 診斷 UTI 常須仰賴臨床症狀合併尿液檢驗、尿液細菌培養、或其他相關檢驗檢查。^{17,20}

2.1 膀胱炎（Cystitis）

- a. 下泌尿道症狀，諸如 dysuria, frequency and urgency，且非受到陰道分泌物影響

2.2 尿道炎（Urethritis）

- a. 此類病人建議同時檢驗性傳染病（ Sexually transmitted infections, STIs ）²¹
- b. Mucoid, mucopurulent, or purulent urethral discharge.
- c. Gram or methylene-blue stain of urethral secretions demonstrating inflammation.
 - (1) ≥ 5 polymorphonuclear leucocytes (PMNL) per high power field (HPF) is the historical cut-off for the diagnosis of urethritis.
- d. The presence of > 10 PMNL/HPF in the sediment from a spun first-void urine sample or a positive leukocyte esterase test in first-void urine.

2.3 Uncomplicated pyelonephritis

- a. Fever ($> 38^{\circ}\text{C}$), chills, flank pain, nausea, vomiting, or costovertebral angle tenderness
 - (1) With or without the typical symptoms of cystitis
- b. Urinalysis is recommended for routine diagnosis, and urine culture and antimicrobial susceptibility testing should be performed in all cases of pyelonephritis.
- c. Evaluation of the upper urinary tract with ultrasound (US) should be performed to rule out urinary tract obstruction or renal stone disease in patients with a history of urolithiasis, renal function disturbances or a high urine pH.

2.4 Catheter-associated UTI (CA-UTI)

- a. In the catheterized patient
 - (1) New onset or worsening of fever, rigors, altered mental status, malaise, or lethargy with no other identified cause, flank pain, costovertebral angle tenderness, acute hematuria, pelvic discomfort.
 - (2) The presence or absence of odorous or cloudy urine alone should not be used to differentiate CA-ABU from CA-UTI.
- b. Dysuria, urgent or frequent urination and suprapubic pain or tenderness in those whose catheters have been removed.
- c. Microbiologically CA-UTI is defined by microbial growth of $> 10^3$

cfu/mL of one or more bacterial species in a single catheter urine specimen or in a mid-stream voided urine specimen from a patient whose catheter has been removed within the previous 48 hours.

- 3 下述情況通常建議「留院治療」或「轉醫院治療」尤佳
 - 3.1 病人已知 90 天內尿液培養曾有多重抗藥性菌種（MDRO）
 - 3.2 病人免疫不全（包含器官移植病人、血液幹細胞移植病人、白血病等血液腫瘤疾病病人、無藥物控制之人類免疫缺乏病毒感染、無脾臟或脾臟功能缺失、控制不佳之糖尿病...等）
 - 3.3 病人在家生活無法自理、無人照料、或醫療依從性差
 - 3.4 病人疾病嚴重度太高、生命徵象不穩定，種種跡象指向 Urosepsis
 - a. 「qSOFA score」≥ 2 分 ± 「SOFA score」≥ 2 分
 - 3.5 病人有泌尿生殖道結構異常，包含腎臟水腫（Hydronephrosis）
 - 3.6 合併其他併發症，包含腎臟膿瘍（Renal abscess）或急性腎衰竭（Acute kidney injury）
 - 3.7 近期有接受泌尿生殖道相關手術
- 4 根據 2021 年台灣抗生素抗藥性監測年報監測資料顯示，全國醫療院所分離之常見 UTI 菌種對 fluoroquinolones 皆有高低不等之抗藥性^{13,22}。因此選用 fluoroquinolones 治療 UTI 時，須考量抗藥性導致治療失敗的可能性。
 - 4.1 美國感染症醫學會（Infectious Diseases Society of America）指出 fluoroquinolone 只應使用在 “prevalence of resistance of community uropathogens to fluoroquinolones is not known to exceed 10%.”²³
 - 4.2 歐洲泌尿外科學會（European Association of Urology）明確指出 “Do not use ciprofloxacin and other fluoroquinolones for the empirical treatment of complicated UTI in patients from urology departments or when patients have used fluoroquinolones in the last six months.”¹⁷

表 4.2，2021 年臺灣常見泌尿道感染菌抗生素抗藥性監測結果

菌名	Ciprofloxacin-sensitive (%)	Levofloxacin-sensitive (%)
<i>Escherichia coli</i>	60	58
<i>Klebsiella pneumoniae</i>	66	66
<i>Proteus mirabilis</i>	63	65

- 5 膀胱炎（Cystitis）或尿道炎（Urethritis），通常不需要住院。除非病患無法回診追蹤或共病不穩定（包含控制不佳之糖尿病、慢性心、肺、腎臟病

變、惡性腫瘤、酗酒者、無脾臟或脾臟功能缺失¹²⁾，可考慮居家口服或注射型抗生素治療。常用口服或單次注射型抗生素如下列^{17,23}：

- 5.1 Oral trimethoprim/sulfamethoxazole 160/800 mg BID (3 days)
- 5.2 Oral amoxicillin/clavulanate (875/125) 1000 mg BID_{PC} (3-7 days) 或
Oral amoxicillin/clavulanate (500/125) 625 mg TID_{PC} (3-7 days)
- 5.3 Oral cephalexin 500 mg QID (3-7 days)
- 5.4 Oral cefuroxime 500 mg Q12H (3-7 days)
- 5.5 Oral fosfomycin trometamol 3000 mg single dose
- 5.6 Oral ofloxacin 400 mg BID_{AC1hr} (3 days) 或
Oral ciprofloxacin 500 mg BID_{AC1hr} (3 days) 或
Oral levofloxacin 750 mg QD_{AC1hr} (3 days)
- 5.7 IV gentamicin 5 mg/kg once 或
IV amikacin 15 mg/kg once
- 6 Uncomplicated pyelonephritis，且過往沒有抗藥性菌種紀錄，可考慮下列居家口服或靜脈注射型抗生素治療^{4,17,23}。
 - 6.1 Oral trimethoprim/sulfamethoxazole 160/800 mg BID (14 days)
 - 6.2 Oral cefuroxime 500 mg Q12H (10-14 days)
 - 6.3 Oral cefixime 400 mg QD (10-14 days)
 - 6.4 IV ceftriaxone 2000 mg once 合併後續 oral cefixime 400 mg QD (14 days) 或 cefuroxime 500 mg Q12H (14 days)
 - 6.5 IV ceftriaxone 2000 mg QD (7 days)
 - 6.6 IV gentamicin 5 mg/kg 或 amikacin 15 mg/kg once 合併後續 oral cefixime 400 mg QD (14 days) 或 cefuroxime 500 mg Q12H (14 days)
 - 6.7 IV gentamicin 5 mg/kg QD⁴ (7 days) 或
IV amikacin 15 mg/kg QD⁴ (7 days)
(第二劑後依照 CCr 調整劑量)
 - 6.8 IV ciprofloxacin 400 mg once 合併後續 oral ciprofloxacin 500 mg BID_{AC1hr} (7 days) (務必注意地區抗藥性，建議確認感受性有效才使用)
 - 6.9 IV levofloxacin 750 mg QD (7 days) 或
IV levofloxacin 750 mg once 合併後續 oral levofloxacin 750 mg QD_{AC1hr} (6 days) (務必注意地區抗藥性，建議確認感受性有效才使用)

- 6.10 (24hr) cefazolin 6000 mg^{24,25} (7 days)
- 6.11 (24hr) cefuroxime 4500 mg¹⁶ (7 days)
- 7 Uncomplicated pyelonephritis，且近 90 天內已知 ESBL-Enterobacterales & AmpC-Enterobacterales，建議藥物如下^{4,23}
- 7.1 IV ertapenem 1000 mg QD (7 days)
- 7.2 IV amikacin 15 mg/kg QD⁴ (7 days) (第二劑後依照 CCr 調整劑量)
- 7.3 IV ciprofloxacin 400 mg once 合併後續 oral ciprofloxacin 500 mg BID_{AC1hr} (7 days) (建議只有在菌種已知且感受性有效情形下方可使用)
- 7.4 IV levofloxacin 750 mg QD (7 days) 或
IV levofloxacin 750 mg once 合併後續 oral levofloxacin 750 mg QD_{AC1hr} (6 days) (建議只有在菌種已知且感受性有效情形下方可使用)
- 8 懷孕女性之所有泌尿道感染皆屬 Complicated UTI，建議與婦產科醫師或感染科醫師討論最適切用藥。
- 8.1 膀胱炎 (Cystitis) 或尿道炎 (Urethritis) 之藥物治療建議 5.2, 5.3, 5.4, 5.5 等四項。
- 8.2 若為 Pyelonephritis，治療建議 6.2, 6.3, 6.4, 6.5, 6.10, 6.11 或 7.1。
- 9 男性病患之所有泌尿道感染皆屬 Complicated UTI，若採居家抗生素治療，治療建議參考 Uncomplicated pyelonephritis (選項 6、7)。
- 10 無症狀導尿管相關菌尿症 (CA-ABU)^{17,20}
- 10.1 Guidelines recommend against screening for or treating asymptomatic bacteriuria, neither in patients with a short-term indwelling urethral catheter (<30 days) nor in patients with long-term indwelling catheters.
- 11 導尿管相關之泌尿道感染 (CA-UTI)¹⁷
- 11.1 Replace or remove the indwelling catheter before starting antimicrobial therapy. The duration of catheterization should be minimal.
- 11.2 Do not use prophylactic antimicrobials to prevent catheter-associated UTIs.
- 11.3 Treat symptomatic catheter-associated UTI according to the recommendations for pyelonephritis (第 6、7 項)。

伍、皮膚軟組織感染（Skin and soft tissue infection, SSTI）

1 皮膚軟組織感染分類（Classifications of SSTI）²⁶

1.1 蜂窩性組織炎（Cellulitis）及丹毒（Erysipelas）

- a. “Cellulitis” and “erysipelas” refer to diffuse, superficial, spreading skin infections.
- b. These infections cause rapidly spreading areas of erythema, swelling, tenderness, and warmth, sometimes accompanied by lymphangitis and inflammation of the regional lymph nodes.
- c. The skin surface may resemble an orange peel (peau d’orange) due to superficial cutaneous edema surrounding hair follicles and causing skin dimpling because the follicles remain tethered to the underlying dermis.
- d. Vesicles, bullae, and cutaneous hemorrhage in the form of petechiae or ecchymoses may develop.
- e. Systemic manifestations are usually mild, but fever, tachycardia, confusion, hypotension, and leukocytosis are sometimes present and may occur hours before the skin abnormalities appear.

1.2 癰（Furuncle）及癰（Carbuncle）

- a. Furuncles (or “boils”) are infections of the hair follicle, usually caused by *S. aureus*, in which suppuration extends through the dermis into the subcutaneous tissue, where a small abscess forms.
 - (1) They differ from folliculitis, in which the inflammation is more superficial and pus is limited to the epidermis.
 - (2) Clinically, furuncles are inflammatory nodules with overlying pustules through which hair emerges.
- b. Infection involving several adjacent follicles produces a carbuncle, a coalescent inflammatory mass with pus draining from multiple follicular orifices.
 - (1) Carbuncles develop most commonly on the back of the neck, especially in individuals with diabetes. These are typically larger and deeper than furuncles.

1.3 Cutaneous abscess

- a. Cutaneous abscesses are collections of pus within the dermis and deeper skin tissues. They are usually painful, tender, and fluctuant red nodules, often surmounted by a pustule and encircled by a rim of erythematous swelling.

1.4 Diabetes-related foot infections (DFIs)²⁷

- a. Infections of the skin and soft tissues of the foot in a person with diabetes most often follow a break in the protective skin envelope.
- b. Diabetes-related foot ulcer (DFU)
 - (1) Usually involves at least the epidermis and part of the dermis.
 - (2) This complication most often occurs in those with peripheral neuropathy, and frequently those with peripheral artery disease (PAD).
- c. Infection follows the colonization of the wound by a complex microbiological flora.
 - (1) While most DFIs are relatively superficial at presentation, microorganisms can spread contiguously to subcutaneous tissues, including fascia, tendons, muscles, joints, and bones.

2 疾病嚴重度定義

2.1 Mild to moderate disease

- a. 意識清楚、生命徵象穩定
- b. 「qSOFA score」低於兩分
- c. 沒有「全身性發炎反應 (SIRS)」

2.2 Severe disease

- a. 意識不清、生命徵象不穩定
- b. 嚴重全身性發炎反應 (SIRS)
- c. 「qSOFA score」 ≥ 2 分 $\pm$ 「SOFA score」 ≥ 2 分
- d. Clinical signs of deeper infection such as bullae, skin sloughing, hypotension.

3 下述情況通常建議「留院治療」或「轉醫院治療」尤佳

3.1 病人已知 90 天內傷口培養曾有多重抗藥性菌種 (MDRO)

3.2 病人免疫不全 (包含器官移植病人、血液幹細胞移植病人、白血病等血液腫瘤疾病病人、無藥物控制之人類免疫缺乏病毒感染、無脾臟

或脾臟功能缺失、控制不佳之糖尿病...等)

3.3 病人在家生活無法自理、無人照料、或醫療依從性差

3.4 病人疾病嚴重度太高、生命徵象不穩定

a. 「qSOFA score」 ≥ 2 分 $\pm$ 「SOFA score」 ≥ 2 分

3.5 感染範圍太大或太深，無法以簡易清創 (Debridement) 處理者，或可能造成肢端缺血 (Ischemia) 或腔室症候群 (Compartment syndrome)

3.6 快速進展，有可能是壞死性筋膜炎 (Necrotizing fasciitis) 或為下述細菌感染：

a. *Vibrio vulnificus*

b. *Aeromonas hydrophila*

c. *Clostridium perfringens* or other *Clostridium spp.*

3.7 Fournier's gangrene

4 Mild to moderate disease，若病患可口服用藥，通常不需要住院。若病患無法回診追蹤或共病不穩定 (包含控制不佳之糖尿病、慢性心、肺、腎臟病變、惡性腫瘤、酗酒者、無脾臟或脾臟功能缺失¹²)，可考慮居家口服或注射型抗生素治療。

4.1 Erysipelas / Cellulitis 建議用藥如下，療程通常 5-7 天²⁶

a. Oral cephalexin 500 mg QID (5-7 days)

b. Oral dicloxacillin 500 mg QID (5-7 days)

c. Oral clindamycin 300 mg QID (5-7 days)

d. IV ceftriaxone 2000 mg QD (5-7 days)

e. (24hr cIF) penicillin G 18 MU^{14,15} (5-7 days)

f. (24hr cIF) cefazolin 6000 mg^{24,25} (5-7 days)

g. (24hr cIF) clindamycin 1800 mg^{28,29} (5-7 days)

4.2 Furuncle / carbuncle / abscess²⁶

a. 通常建議 Incision and drainage (I&D) + culture，合併下述藥物治療，療程通常 5-7 天

(1) Oral trimethoprim/sulfamethoxazole 160/800 mg BID (5-7 days)

(2) Oral doxycycline 100 mg BID_{PC} (5-7 days)

(3) IV ceftriaxone 2000 mg QD (5-7 days)

(4) (24hr cIF) cefazolin 6000 mg^{24,25} (5-7 days)

(5) (24hr cIF) clindamycin 1800 mg^{28,29} (5-7 days)

4.3 Diabetes-related foot infections (DFIs) 建議用藥如下，療程通常建議 7-14 天²⁷

- a. Oral cephallexin 500 mg QID (7-14 days)
- b. Oral dicloxacillin 500 mg QID (7-14 days)
- c. Oral clindamycin 300 mg QID (7-14 days)
- d. Oral amoxicillin/clavulanate (875/125) 1000 mg BID_{PC} (7-14 days)或
Oral amoxicillin/clavulanate (500/125) 625 mg TID_{PC} (7-14 days)
- e. IV ceftriaxone 2000 mg QD (7-14 days)
- f. (24hr cIF) cefazolin 6000 mg^{24,25} (7-14 days)
- g. (24hr cIF) clindamycin 1800 mg^{28,29} (7-14 days)
- h. (24hr cIF) cefuroxime 4500 mg¹⁶ (7-14 days)
- i. 若病人糖尿病足部感染 (DFIs) 同時併存周邊動脈阻塞 (PAD)，
建議用藥合併厭氧菌治療，通常建議選項 c, d, g，或其他選項合併
clindamycin 共同治療。

5 Severe disease

- 5.1 通常急診病人建議「留院治療」、居家病人建議「轉醫院治療」，必要時需轉至加護病房治療。
- 5.2 依照病患病原菌、疾病影響範圍，治療選擇可參考上述（第 4.1、4.2、4.3 項）之注射型藥物，或諮詢感染症專家意見。建議療程至少 7-14 天不等，必要時依照病況延長療程。

6 若已知病原菌

6.1 *Streptococcus pyogenes* 或其他 *Streptococcus spp.*

- a. 一般療程為 5-7 天，但須視病況及治療反應延長
- b. Oral cephallexin 500 mg QID (5-7 days)
- c. Oral clindamycin 300 mg QID (5-7 days)
- d. Oral amoxicillin 1000 mg Q8H (5-7 days)
- e. (24hr cIF) penicillin G 18 MU^{14,15} (5-7 days)
- f. IV ceftriaxone 2000 mg QD (5-7 days)

6.2 Methicillin-susceptible *Staphylococcus aureus* (MSSA)

- a. 一般療程為 7 天，但須視病況及治療反應延長
- b. Oral dicloxacillin 500 mg QID (7 days)

- c. Oral cephalexin 500 mg QID (7 days)
- d. Oral clindamycin 300 mg QID (7 days)
- e. (24hr cIF) cefazolin 6000 mg^{24,25} (7 days)
- f. (24hr cIF) clindamycin 1800 mg^{28,29} (7 days)

6.3 Methicillin-resistant *Staphylococcus aureus* (MRSA)

- a. 一般療程為 7 天，但須視病況、抗藥性及治療反應延長，並諮詢感染症專家調整最適切藥物。通常建議「留院治療」或「轉醫院治療」尤佳
- b. Oral trimethoprim/sulfamethoxazole 160/800 mg BID (7 days)
- c. Oral doxycycline 100 mg BID_{PC} (7 days)
- d. Oral clindamycin 300 mg QID (7 days)
- e. (24hr cIF) clindamycin 1800 mg^{28,29} (7 days)

6.4 *Vibrio vulnificus*, *Aeromonas hydrophila*, *Clostridium spp.*

- a. 強烈建議急診病人「留院治療」、居家病人「轉醫院治療」，儘速安排手術清創，並諮詢感染症專家調整最適切藥物。

7 Dog / Cat / Human bite

7.1 一般療程為 5-7 天，但須視病況及治療反應延長

7.2 非狗、貓、或人類之其他種類動物咬傷通常建議「留院治療」或「轉醫院治療」尤佳，藥物選擇亦參照第 7.4 項。

7.3 請依照下表情形，評估病人是否須注射破傷風類毒素（Tetanus toxoid）³⁰。

表 7.3，受傷後傷口之預防破傷風處理措施原則

傷口種類	小、乾淨		所有其他種類傷口	
病人過往破傷風疫苗或類毒素注射記錄	破傷風類毒素（Tetanus toxoid）	破傷風免疫球蛋白	破傷風類毒素（Tetanus toxoid）	破傷風免疫球蛋白
不確定或小於三次	需要	不需要	需要	需要
三次或三次以上	不需要 若已超過十年 需追加一次	不需要	不需要 若已超過五年 需追加一次	不需要

7.4 若病患可口服用藥，通常不需要住院。若病患無法回診追蹤或共病不穩定（包含控制不佳之糖尿病、慢性心、肺、腎臟病變、惡性腫瘤、

酗酒者、無脾臟或脾臟功能缺失¹²⁾，可考慮居家口服或注射型抗生素治療。建議藥物如下列²⁶

- a. Oral amoxicillin/clavulanate (875/125) 1000 mg BID_{PC} (5-7 days) 或
Oral amoxicillin/clavulanate (500/125) 625 mg TID_{PC} (5-7 days)
- b. Oral doxycycline 100 mg BID_{PC} (5-7 days)
- c. Oral clindamycin 300 mg TID (5-7 days)
- d. Oral cefuroxime 500 mg Q12H (5-7 days) 並考慮合併 oral
clindamycin 300 mg TID
- e. IV ceftriaxone 2000 mg QD (5-7 days) 並考慮合併 oral clindamycin
300 mg TID
- f. (IV or oral) moxifloxacin 400 mg QD_{AC1hr} (5-7 days)
- g. (24hr cIF) clindamycin 1800 mg^{28,29} (5-7 days)
- h. (24hr cIF) cefuroxime 4500 mg¹⁶ (5-7 days) 並考慮合併 oral
clindamycin 300 mg TID

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附件 1，居家靜脈注射抗生素與肌酐清除率（Creatinine Clearance Rate, CCr）對應之劑量建議及稀釋濃度建議

靜脈注射抗生素及建議稀釋濃度	CCr	>60	60	55	50	45	40	35	30	25	20	15	10	5	ESRD HD	PD	
Amikacin once (5 mg/mL)		15mg/kg once													15mg/kg once	15mg/kg once	
Amikacin 7 days (5 mg/mL)		15mg/kg QD			15mg/kg st, 7.5mg/kg QD									15mg/kg st 7.5 QOD	7.5mg/kg TIW AD	7.5mg/kg QOD	
Cefazolin (20 mg/mL)		6000mg 24hr cIF			4000mg 24hr cIF			2000mg QD			1000mg QD		1000mg QD AD		1000mg QD		
Cefepime (20-40 mg/mL)		6000mg 24hr cIF		4000mg 24hr cIF				2000mg QD			1000mg QD		1000mg QD AD		1000mg QD		
Ceftazidime (20-40 mg/mL)		6000mg 24hr cIF			4000mg 24hr cIF			2000mg QD			1000mg QD		1000mg QD AD		1000mg QD		
Ceftriaxone (20-40 mg/mL)		2000mg QD													2000mg QD	2000mg QD	
Cefuroxime (15-30 mg/mL)		4500mg 24hr cIF						3000mg 24hr cIF			1500mg QD		1500mg QD AD		1500mg QD		
Clindamycin (12 mg/mL)		1800mg 24hr cIF													1800mg 24hr cIF	1800mg 24hr cIF	
Ertapenem (20 mg/mL)		1000mg QD						500mg QD						500mg QD AD		500mg QD	
Gentamicin once (3 mg/mL)		5-7mg/kg once													5-7mg/kg once	5-7mg/kg once	
Gentamicin 7 days (3 mg/mL)		5-7mg/kg QD			2mg/kg QD						2mg/kg QOD		2mg/kg TIW AD		0.6mg/kg IP QD		
Levofloxacin (no dilution)		750mg QD			750mg QOD						750mg st 500mg QOD		750mg st 500mg QOD AD		750mg st 250mg QD		
Moxifloxacin (no dilution)		400mg QD													400mg QD	400mg QD	
Nemonoxacin (no dilution)		500mg QD		No data									No data		No data		
Penicillin G (0.04-0.1 MU/mL)		18MU 24hr cIF			12MU 24hr cIF			6MU 24hr cIF						9MU 24hr cIF AD		12MU 24hr cIF	
Piperacillin/Tazobactam (90 mg/mL)		18000mg 24hr cIF						13500mg 24hr cIF			9000mg 24hr cIF			6750mg 24hr cIF		6750mg 24hr cIF	

備註：以體重計算之藥物，以取整數為原則。st = STAT, AD = After dialysis

Ref : Sanford guide, UpToDate, Manrique-Rodriguez S, et al.(doi: 10.1007/s40268-020-00329-w.)

附件 2，居家口服抗生素劑量及肌酐清除率（Creatinine Clearance Rate, CCr）對應之劑量建議

口服抗生素	CCr	>60	60	55	50	45	40	35	30	25	20	15	10	5	ESRD HD	PD		
Amoxicillin (PO)		1000mg Q8H								1000mg Q12H			500mg Q12H		500mg Q12H AD	500mg Q12H		
Amoxicillin/Clavulanate (PO,875/125)		1000mg BID _{PC}								1000mg QD _{PC}			500mg QD _{PC}		500mg QD _{PC} AD	1000mg QD _{PC}		
Amoxicillin/Clavulanate (PO,500/125)		625mg TID _{PC}								625mg BID _{PC}			625mg QD _{PC}		625mg QD _{PC} AD	625mg BID _{PC}		
Azithromycin (PO)		500mg QD _{PC}														500mg QD _{PC}	500mg QD _{PC}	
Cefuroxime (PO)		500mg Q12H								500mg QD			250mg QD		250mg QD AD	No Data		
Cephalexine (PO)		500mg QID								500mg TID			500mg BID		500mg BID AD	500mg QD		
Ciprofloxacin (PO)		750mg BID _{AC1hr}				500mg BID _{AC1hr}				500mg QD _{AC1hr}					500mg QD _{AC1hr} AD	500mg Q12		
Clindamycin (PO)		300mg TID-QID														300mg TID-QID	300mg TID-QID	
Dicloxacillin (PO)		500mg Q6H														500mg Q6H	500mg Q6H	
Doxycycline (PO)		100mg BID _{PC}														100mg BID _{PC}	100mg BID _{PC}	
Levofloxacin (PO)		750mg QD _{AC1hr}				750mg QOD _{AC1hr}				750mg st, 500mg QOD _{AC1hr}			750mg st 500mg QOD _{AC1hr} AD		750mg st 500mg QOD _{AC1hr}			
Metronidazole (PO)		500mg Q8H														500mg Q8H	500mg Q8H	
Moxifloxacin (PO)		400mg QD _{AC1hr}														400mg QD _{AC1hr}	400mg QD _{AC1hr}	
Nemonoxacin (PO)		500mg QD _{AC1hr}	No Data														No Data	No Data
Ofloxacin (PO)		400mg BID _{AC1hr}				400mg QD _{AC1hr}				200mg QD _{AC1hr}			200mg QD _{AC1hr} AD		200mg QD _{AC1hr}			
Trimethoprim/Sulfamethoxazole(PO)		2# (160/800) BID								2# (160/800) QD					2# (160/800) QD		2# (160/800) QD	

備註：以體重計算之藥物，以取整數為原則。st = STAT, AD = After dialysis, AC1hr = 飯前空腹一小時, PC = 飯後, PO = oral

Ref : Sanford guide, UpToDate

附件 3，居家靜脈注射抗生素稀釋溶液、稀釋後濃度、稀釋後酸鹼值及輸注注意事項。

藥物學名 Drug	稀釋後濃度 Concentration	稀釋液 Diluent	Density (g/mL)	平均滲透壓 Mean osmolarity (mOsm/L)	pH	注意血管 炎風險 ^註	其他
Amikacin	5 mg/mL (500 mg/100 mL)	D5W	1.047	322	4.42±0.01	V	滴注 60 分鐘以上
		NS	1.034	293	4.87±0.01	V	
Cefazolin	20 mg/mL (2 g/100 mL)	D5W	1.026	326	5.04±0.01		
		NS	1.017	315	4.94±0.03	V	
Cefepime	20 mg/mL (1 g/50 mL)	D5W	1.033	457	4.10±0.03	V	
		NS	1.018	422	4.26±0.01	V	
	40 mg/mL (2 g/50 mL)	D5W	1.041	581	4.11±0.04	V	
		NS	1.030	556	4.30±0.01	V	
		1/2S	1.022	396	4.30±0.01	V	
Ceftazidime	20 mg/mL (1 g/50 mL)	D5W	1.023	324	6.71±0.01		
		NS	1.015	311	6.95±0.01		
	40 mg/mL (2 g/50 mL)	D5W	1.028	341	6.61±0.01		
		NS	1.022	332	6.93±0.01		
Ceftriaxone	20 mg/mL (1 g/50 mL)	D5W	1.031	404	6.57±0.03		滴注 30 分鐘以上
		NS	1.018	378	6.61±0.08		
	40 mg/mL (2 g/50 mL)	D5W	1.041	494	6.66±0.06	V	
		NS	1.028	467	6.72±0.02	V	

		1/2S	1.016	310	6.36±0.01		
Cefuroxime	15 mg/mL (750 mg/50 mL)	D5W	1.027	338	6.04±0.03		
		NS	1.013	322	6.81±0.03		
	30 mg/mL (1500 mg/50 mL)	D5W	1.028	365	6.41±0.03		
		NS	1.019	353	6.73±0.03		
Ciprofloxacin	3 mg/mL	無需稀釋	1.043	303	4.30±0.01	V	滴注 60 分鐘以上
Clindamycin	9 mg/mL (900 mg/100 mL)	D5W	1.024	337	6.43±0.01		
		NS	1.011	308	6.27±0.02		
	12 mg/mL (600 g/50 mL)	D5W	1.025	350	6.81±0.01		
		NS	1.013	322	6.69±0.02		
Ertapenem	20 mg/mL (1 g/50 mL)	NS	1.018	395	7.76±0.01		滴注 30 分鐘以上
Gentamicin	3 mg/mL	NS/D5W	1.033	307	4.62±0.02	V	滴注 60 分鐘以上
Levofloxacin	5 mg/mL	無需稀釋	1.032	312	5.16±0.01		滴注 90 分鐘以上
Moxifloxacin	No Data	無需稀釋	No Data	270-320	4.1-4.6	V	滴注 60 分鐘以上
Nemonoxacin	No Data	無需稀釋	No Data	No Data	No Data	V	滴注 60 分鐘以上
Penicillin G	40,000 UI/mL	NS	1.014	385	5.81±0.01		
	100,000 UI/mL	NS	1.031	629	6.13±0.01	V	
		1/2S	1.021	436	6.12±0.01		
Piperacillin/Tazobactam	45 mg/mL (2.25 g/50 mL)	D5W	1.031	415	5.53±0.02		
		NS	1.023	390	5.68±0.01		
		D5W	1.044	501	5.77±0.02	V	

	90 mg/mL (4.5 g/50 mL)	NS	1.037	482	5.78±0.01	V	
		1/2S	1.036	458	5.31±0.01	V	

Abbreviations : D5W, dextrose 5% water; NS, 0.9% normal saline; 1/2S, 0.45% saline.

備註：血管炎（Infusion-related phlebitis）風險藥物係指藥物調配後具有極端酸鹼值（pH <5 or >9）、高滲透壓（osmolarity values, moderate risk 450-600 mOsm/L, high risk > 600 mOsm/L）、或藥物本身具有起疱性（Vesicant）。

Adapted from

1. Manrique-Rodríguez S, et al. Standardization and Chemical Characterization of Intravenous Therapy in Adult Patients: A Step Further in Medication Safety. *Drugs R D*. 2021 Mar;21(1):39-64. doi: 10.1007/s40268-020-00329-w.

2. Borgonovo F, et al. Physicochemical Characteristics of Antimicrobials and Practical Recommendations for Intravenous Administration: A Systematic Review. *Antibiotics (Basel)*. 2023 Aug 19;12(8):1338. doi: 10.3390/antibiotics12081338.