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# Safe and effective short-course intravenous antibiotic therapy in neonates under 28 days with urinary tract infection

**Mathilde Baudin**

mathilde.baudin@aphp.fr

Sorbonne University

**Jean-Daniel Delbet**

Sorbonne University

**Charlène Ferrandiz**

Sorbonne University

**Martin Auger**

Sorbonne University

**Gael Cals**

Sorbonne University

**Antoine Mouche**

Sorbonne University

**Mathie Lorrot**

Sorbonne University

**Tim Ulinski**

Sorbonne University

**Cyrielle Parmentier**

Sorbonne University

**Research Article**

**Keywords:**

**Posted Date:** March 22nd, 2026

**DOI:** https://doi.org/10.21203/rs.3.rs-8917425/v1

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**Additional Declarations:** No competing interests reported.

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**Version of Record:** A version of this preprint was published at European Journal of Pediatrics on October 8th, 2026. See the published version at https://doi.org/10.1007/s00431-026-07412-5.

# Abstract

### Aims

Evidence guiding the optimal duration of intravenous (IV) antibiotic therapy for urinary tract infections (UTI) in neonates under 28 days remains scarce. This study aimed to evaluate the feasibility and safety of a short IV antibiotic course (≤ 4 days) in neonates with UTI.

### Methods

We conducted a retrospective single-center study including neonates < 28 days hospitalized for culture-proven UTI (≥ 10,000 leukocytes/mL and ≥ 10,000 CFU/mL of a single pathogen). Demographic, clinical, laboratory, imaging, and treatment data were collected. Patients were stratified as low-risk (no severity criteria) or high-risk (clinical severity, bacteremia, pyelo-ureteral dilatation, or ESBL infection). The primary endpoint was 30-day recurrence after IV therapy.

### Results

A total of 138 patients were included; (82% male, median age 15.5 days). 97 patients (71%) were classified as low-risk, and 95 of them (98%) received a short IV antibiotics (≤ 4 days). Only one early recurrence occurred related to poor oral intake of antibiotic treatment during viral co-infection. *Escherichia coli* was the predominant pathogen (88%). ESBL identified in 3.6% of neonates. Fifty-one patients (37%) were younger than 14 days, they presented less frequently with fever but received similar short IV courses without increased recurrence.

### Conclusion

Short-course IV antibiotic therapy followed by oral treatment appears safe and effective for carefully selected neonates under 28 days with UTI and low risk factors for severe infection. These findings support a more tailored approach to antibiotic duration in this age group and call for prospective multicenter validation.


# What is Known

Evidence supports short IV antibiotic courses in infants >28 days with UTI.

Robust recommendations are lacking for neonates <28 days.

### What is New

In clinically stable neonates <28 days without bacteremia, short IV therapy was not associated with increased recurrence.

Even neonates ≤14 days can be safely managed with this approach.

# Introduction

Urinary tract infection (UTI) is the most frequent serious bacterial infection in neonates. Approximately 10–20% of febrile episodes in infants younger than 60 days are attributed to UTIs (1) (2), making them a leading cause of hospitalization in this age group. In the United States alone, over 20,000 children under the age of 1 year are hospitalized annually for UTIs (3).

In UTIs of infants older than 28 days, intravenous (IV), antibiotics are not always required : oral and parenteral treatments have demonstrated comparable efficacy, and the parenteral phase is usually limited to less than 4 days. (4). According to guidelines, antibiotic selection should be tailored based on local antimicrobial resistance patterns. The 2024 French guidelines recommend initial hospitalization with intravenous therapy for infants < 3 months. No recommendations are provided regarding oral step-down therapy, and empirical oral antibiotics at diagnosis are not advised (5). Prolonged IV antibiotic therapy, is generally reserved for high risk situations (initial sepsis, uropathy, bacteremia), or UTI caused by an Extended-spectrum beta-lactamase (ESBL)-producing organism, when oral therapy is not feasible (6).

In clinical practice, it is essential to determine the optimal time to switch from intravenous to oral antibiotic treatment. Insufficient treatment of UTIs increases the risk of recurrence, urosepsis (7), and long-term complications such as renal scarring. At this age, intravenous treatment cannot be administered on an outpatient basis and requires hospitalization. Shortening the duration of IV therapy offers several advantages: it reduces the risk of complication related to intravenous lines and medications -related adverse events (8); it limits disruption to parent-infant bonding (9), it decreases the length of hospital stay, thereby increasing bed availability and reducing healthcare costs (10). A recent systematic review (2022) concluded that shorter IV antibiotic courses (≤ 7 days in cases of bacteremia and < 4 days without bacteremia) are appropriate for managing urinary tract infections (UTIs) in infants under 3 months of age, without meningitis, or sepsis (11).

For neonates younger than 28 days, evidence-based recommendations on the optimal duration of IV antibiotic therapy are lacking. Current European, American, and Asian guidelines provide no specific guidance for this age group (12–15). Although American studies report no increased 60-day recurrence risk with short IV courses (< 4 days) (7, 16), they included broader infant populations, leaving uncertainty for neonates < 28 days. Within this group, two aspects warrant attention: infants ≤ 14 days, who may present atypically, and the potential role of procalcitonin (PCT) as a severity marker(16).

The present studyfocuses specifically on neonates under 28 days. Our objectives were to describe their clinical and microbiological characteristics and to assess whether criteria, established for older infants, can be safely applied to support short IV antibiotic course (< 4 days), without increasing the risk of early recurrence.

# Patients and Methods

# Study design and Population

We conducted a retrospective cohort study at the university Trousseau Hospital, between 2019 to 2023. Eligible participants were infants under 28 days of age who presented to the emergency department and were subsequently hospitalized with a diagnostic of UTI. UTI was defined as the presence of ≥ 10,000 leukocytes /mL in urinalysis and ≥ 10,000 CFUs/mL of a single pathogen in urine culture. Patients were identified using ICD-10 (International Classification of Diseases) codes: N10 (acute tubulointerstitial nephritis) and N11 (chronic tubulointerstitial nephritis). We excluded preterm infants (< 35 weeks gestational age), meningitis or viral co-infections.

## Data Collection

We collected demographic and clinical data included sex, age, weight, and the presence of risk factors for early neonatal bacterial UTIs.

Clinical severity at presentation was assessed based on poor peripheral perfusion (skin recoloration time greater than 3 seconds, mottling, systolic blood pressure below 60 mmHg), need for fluid resuscitation, or admission to intensive care.

Laboratory data was collected at the initial presentation to the emergency department and included blood culture results, C-reactive protein (CRP), procalcitonin (PCT), total white blood cell count, neutrophil count, urine culture results, and bacterial identification. All patients underwent renal ultrasonography before the third day of treatment.

Therapeutic data included antibiotic regimen details: route of administration, total length of hospital stay, and duration of fever following antibiotic initiation.

Follow-up data encompassedprescription of antibiotic prophylaxis, voiding cystourethrography results, and vesicoureteral reflux (VUR) grading according to the International System of Radiographic Grading.

## Risk stratification and treatment duration

Patients were stratified according to the risk of severe infection, based on international recommendations for infants aged 1–3 months (11–14), with additional safety criteria adapted for our neonatal population. These adaptations were implemented to ensure a conservative and standardized approach to treatment decisions.

**Low-risk group**

neonates with no risk factors for severe infection.

**High-risk group**

neonates presenting with one or more of the following risk factors

- Clinical severity at presentation (poor perfusion, need for fluid resuscitation, or intensive care admission)
- Concurrent bacteremia
- Presence of pyelo-ureteral dilatation on renal imaging, considered a potential marker of underlying uropathy and added as a safety criterion in our protocol
- Infection caused by ESBL–producing organisms, limiting oral antibiotic options

IV antibiotic duration was categorized as:

- Short course: ≤4 days of IV therapy
- Long course: >4 days of IV therapy

All patients subsequently completed a total of 10-days antibiotic course, with oral therapy following the IV phase.

## Primary Endpoint

The primary endpoint was a favorable infection course, defined as absence of UTI recurrence within 30 days of discharge. A 30 days window was chosen because most neonatal UTI recurrences occur within the first month, and this cut-off is used in previous pediatric studies (11). Recurrence was defined as readmission with culture-proven UTI with the same pathogen.

## Secondary Endpoints included:

Secondary outcomes included (i) the clinical and biological description of neonates ≤ 14 days of age compared with older infants, and (ii) the association between elevated procalcitonin (PCT > 0.5 µg/L) and clinical or radiological features.

# Statistical analysis

Descriptive statistics for quantitative variables were presented as median with interquartile range (IQR, 25th -75th percentiles), and qualitative variables were expressed as frequencies and percentages. The normality of distribution for continuous variables was assessed using the Shapiro-Wilk test. For comparing dichotomous variables between groups, the chi-square test or Fisher's exact test was used as appropriate. For continuous variables with non-normal distribution, the Mann-Whitney U test was applied. A p-value < 0.05 was considered statistically significant. All statistical analyses were performed using Sigma Plot.

## Results

# Patient characteristics

Of the 156 neonates initially identified, 138 were included in the final analysis. Eighteen neonates were excluded: 5 were born prematurely, 8 presented nosocomial UTI, and 5 presented UTI associated with meningitis (Fig. 1). The cohort comprised 113 boys (82%) with a median age of 15.5 days. Risk factor for neonatal infection were identified in 50 patients (36%).

Clinical severity at presentation was observed in 4 patients (3%): they presented with signs of peripheral hypoperfusion and received fluid resuscitation; two of them were admitted to the intensive care unit, and one of these had bacteremia.

Bacteremia was documented in 4 neonates (3%), and pyelo-ureteral dilatation (unilateral or bilateral) in 36 patients (26%). Fever was present in 97 patients (70%) with 23 (17%) febrile for more than 12 hours before admission. At the initial presentation to the emergency department, median CRP was 26 mg/L [IQR 4; 69] and median PCT was 0.38 µg/L [IQR 0.16; 1.97]. Imaging evidence of nephritis or pyelitis was present in 35 patients (25%) (Table 1).

Table 1
Clinical and biological characteristics at the diagnosis of UTI according to infection risk group

| **Male sex, n (%)** | **Low-risk** | **High-risk** | **Total** |
|---|---|---|---|
| | ***n = 97*** | ***n = 41*** | ***n = 138*** |
| | **77 (79)** | **36 (87)** | **113 (82)** |
| Age (days), median [IQR] | 15.5 [12 ; 22] | 16 [13 ; 22] | 15.5 [12 ; 22] |
| Age < 14 days | 40 (41) | 11 (27) | 51 (37) |
| Weight (g), median [IQR] | 3695 [3298 ; 4000] | 3800 [3500 ; 4025] | 3700 [3336 ;4000] |
| Perinatal infection risk factors, n (%) | 35 (36) | 15 (36) | 50 (36) |
| Maternal fever during delivery, n (%) | 14 (14) | 5 (12) | 19 (14) |
| Prolonged rupture of membranes > 12 h, n (%) | 25 (26) | 11 (27) | 36 (26) |
| **Clinical presentation** | | | |
| Presence of fever, n (%) | 66 (68) | 31 (75) | 97 (70) |
| Onset of fever 12h before consultation, n (%) | 17 (18) | 6 (14) | 23 (17) |
| Initial clinical severity, n (%) | 0 (0) | 3 (7) | 3 (2.1) |
| ICU admission after, n (%) | 0 (0) | 1 (2) | 1 (0.7) |
| **Laboratory findings** | | | |
| CRP (mg/L), median [IQR] | 24 [4 ; 54.5] | 46 [10.9; 93] | 26 [4 ; 69] |
| PCT (µg/L), median [IQR] | 0.25 [0.12 ; 1.9] | 1.1 [0.21 ; 5.3] | 0.38 [0,16 ; 1.97] |
| Blood leukocyte (×10⁹/L), median [IQR] | 13 [9.6 ; 18] | 12 [9.5 ; 15] | 12.3 [9.5 ; 16.7] |
| Neutrophil count (×10⁹/L), median [IQR] | 6.7 [4.2 ; 9.32] | 5.8 [3.1 ; 8.4] | 6.6 [3.3 ; 9] |
| **Imaging findings** | | | |
| Nephritis or pyelitis, n (%) | 22 (23) | 13 (32) | 35 (25.3) |
| Unilateral dilatation, n (%) | 0 (0) | 17 (41) | 17 (12) |
| Bilateral dilatation, n (%) | 0 (0) | 19 (46) | 19 (14) |

*Data are expressed as median [interquartile range] or number (percentage). "Low-risk" corresponds to neonates with no risk factors for severe infection. "High-risk or ESBL" includes neonates presenting with at least one risk factor (clinical severity, bacteremia, pyelo-ureteral dilatation, or infection due to an extended-spectrum beta-lactamase [ESBL]–producing organism). CRP: C-reactive protein; PCT: procalcitonin; ICU: intensive care unit.*

Regarding microbiology, *Escherichia coli* was the predominant pathogen (n = 121, 88%), followed by others enterobacteria (n = 13, 9%), *Enterococcus faecalis* (n = 3, 2%) and *Staphylococcus aureus* (n = 1, 0.7%). In 3.6% of cases (5/138), the infection was caused by an *Escherichia coli* ESBL-producing organism.

# Management and risk of early recurrence of UTI

Among the 138 patients, 97 (91%) had no risk factors for severe infection. Of these low-risk patients, 95 (98%) received IV antibiotics for less than 4 days. Only two low-risk patients received longer IV courses: one due to a significantly elevated PCT level of 32 µg/L, and one without clear explanation.

Early UTI recurrence occurred in only one patient, during respiratory syncytial virus (RSV) bronchiolitis and with vomiting that impaired oral antibiotic intake (Table 2).

Initial IV antibiotic therapy consisted of Cefotaxime (100–150 mg/kg/day), combined with one or two doses of an aminoglycoside (Amikacin 15–20 mg/kg/day or Gentamicin 5–10 mg/kg/day).

Oral antibiotic prescription was guided by susceptibility profiles, cefixime (8 mg/kg/day) was the most frequently prescribed oral agent (89 patients, 64%), followed by amoxicillin (100 mg/kg/day) (22,10%), trimethoprim-sulfamethoxazole 320 mg/kg/day of trimethoprim (10,7%), and amoxicillin-clavulanate (80 mg/kg/day of amoxicillin) (64%). Trimethoprim-sulfamethoxazole was prescribed only in infants aged > 25 days at the time of oral switch. Among patients with ESBL infections, oral therapy was not possible for 2 /5, while the remaining 3 were treated with a combination of amoxicillin–clavulanate (80 mg/kg/day of amoxicillin) and cefixime (8 mg/kg/j) as a synergic therapy. When an oral switch was possible, all patients received a total of 10 days of antibiotic therapy.

# Follow up Outcomes

The median follow-up duration was 2.8 years. Antibiotic prophylaxis was prescribed at discharge for 26 neonates (18.8%) by Cefaclor10 mg/kg/j. Voiding cystourethrography was performed in 23 patients (16.8%), identifying VUR in 11 cases (8% of the cohort). Late recurrent UTI beyond the 30-day was documented in 10 patients (6.5%) during long-term follow-up. Among 36 patients with pyelo-ureteral dilatation, 4 (11%) experienced recurrent UTI, three of these had high-grade VUR (Table 2). Five patients without urological anomalies experienced recurrent UTIs, all before 2 years of age.

# Factor associated with increased PCT (> 0.5 µg/L)

Elevated PCT was observed in 59 patients (43%), including 36 / 97 (37%) patients without risk UTI's factors. Compared to patients with normal PCT levels, those with elevated PCT more frequently presented with pyelitis or nephritis (22/59 vs 13/79, p = 0.018) and bacteremia (4/59 vs 0/79, p = 0.029). No significant differences were observed for ultrasound abnormalities or VUR.

# Neonates under 14 days of age

Fifty-one neonates (37%) were less than 14 days old. This group did not present more risk factors for neonatal bacterial infection. Interestingly, fever was less frequent(55 versus 79%, p = 0.03) compared to neonates older than 14 days. In the absence of fever, the reasons for consultation included discomfort/ irritability (21%), poor feeding (17%), and/or persistent jaundice (3%). CRP levels were lower in this group: 10 mg/L [4; 53] versus 32 mg/L [11; 86], whereas PCT was more frequently elevated among neonates older than 14 days. No significant differences were observed in total leukocyte count or neutrophil count between the groups.

Importantly, 92% of neonates in both age groups received short-course IV therapy (≤ 4 days), without significant differences in recurrence rates (Table 3).

Table 3
Clinical, biological and follow-up characteristics of neonates with UTI according to age (< 14 days vs ≥ 14 days)

| **Male sex, n (%)** | **Neonates < 14 days** *n = 51* | **Neonates ≥ 14 days** *n = 87* | **p** |
|---|---|---|---|
| | **40 (78)** | **73 (84)** | **0.49** |
| Perinatal infection risk factors, n (%) | 19 (37) | 31 (36) | 0.85 |
| Maternal fever, n (%) | 7 (13) | 12 (14) | 1 |
| Prolonged rupture of membranes > 12 h, n (%) | 17 (33) | 19 (22) | 0.16 |
| **Clinical parameters** | | | |
| Fever, n (%) | 28 (55) | 69 (79) | 0.003 |
| Fever > 12 h before admission, n (%) | 4 (8) | 19 (22) | 0.50 |
| Clinical severity at presentation, n (%) | 1 (2) | 2 (2) | 1 |
| ICU admission after, n(%) | 0 (0) | 1 (1) | 1 |
| **Biological parameters** | | | |
| CRP (mg/L), median [IQR] | 10 [4 ; 53] | 32 [11 ; 86] | 0.02 |
| PCT (µg/L), median [IQR] | 0.2 [0.1 ; 1] | 0.87 [0.2 ; 2] | 0.06 |
| PCT > 0.5 µg/L, n (%) | 18 (35) | 41 (47) | 0.03 |
| Bacteremia, n (%) | 2 (4) | 2 (2) | 0.66 |
| ESBL-producing organism, n (%) | 1 (2) | 4 (5) | 0.65 |
| **Ultrasound findings** | | | |
| Nephritis or pyelitis, n (%) | 14 (27) | 21 (24) | 0.68 |
| Unilateral dilatation, n (%) | 3 (6) | 12 (14) | 0.17 |
| Bilateral dilatation, n (%) | 8 (16) | 14 (16) | 1 |
| **Management and follow up** | | | |
| IV antibiotic duration ≤ 4 days, n (%) | 47 (92) | 80 (92) | 1 |
| Recurrent UTI ≤ 30 days, n (%) | 0 (0) | 1 (1) | 1 |
| VUR diagnosed, n (%) | 5 (10) | 4 (5) | 0.46 |
| Recurrent UTI during follow-up, n (%) | 5 (10) | 6 (7) | 0.53 |

*Data are expressed as median [interquartile range] or number (percentage). P values were calculated using the chi-square or Fisher's exact test for categorical variables and the Mann–Whitney U test for continuous variables.*
*CRP: C-reactive protein; PCT: procalcitonin; ICU: intensive care unit; ESBL: extended-spectrum beta-lactamase; VUR: vesicoureteral reflux*

# Discussion

Our study demonstrates that neonates under 28 days of age with UTI and no risk factors for severe infection, can be safely treated with short-course IV antibiotics (≤ 4 days), followed by oral therapy.

In this population, 98% of low-risk neonates achieved a favorable outcome without early recurrence, with the single recurrence occurred in the context of a viral co-infection (RSV bronchiolitis) with vomiting that likely compromised oral antibiotic absorption. These findings are consistent with previous studies in young patients. Marsh & al. reported 112 neonates under 28 days of age with UTI and reported that 51% received IV treatment for less than 48 hours without any pyelonephritis recurrence, but detailed clinical and biological correlates were not provided (17). Our study advances this knowledge by confirming that four simple criteria permit short-course IV treatment: absence of initial clinical severity, bacteremia, pyelo-ureteral dilatation, and resolution of fever within two days of treatment initiation (Fig. 2).

All bacteremic UTIs in our cohort were treated with prolonged IV therapy (4–5 days) followed by oral antibiotics for a total duration of 10 days, consistent with the favorable outcomes reported by Desai et al. (18).

Two secondary findings deserve emphasis. First, neonates ≤ 14 days—often considered more vulnerable—were managed similarly to older infants, without increased recurrence risk. This contrasts with Lewis (6) and supports short IV courses in carefully selected low-risk neonates, even in the first two weeks of life. Second, elevated PCT was associated with pyelitis/nephritis and bacteremia, but not with vesicoureteral reflux, particularly high-grade reflux, unlike findings by Pei-Fen Liao et al. (19). The small number of reflux cases (11/138) may explain this discrepancy.

CRP and PCT interpretation should remain cautious, as biomarker timing relative to fever onset varied. Notably, some neonates presented with UTI despite low CRP/PCT levels and no fever, likely reflecting lower urinary tract infections. This phenotype suggests that not all neonatal UTIs represent severe or ascending infections and raises the question of whether selected cases could safely receive shorter antibiotic courses, warranting further studies. The strengths of our study include the relatively large cohort for this rare population, standardized risk stratification, and strong real-world applicability. However, several limitations must be acknowledged. First, the retrospective single-center design introduces potential selection bias and limits standardization of management decisions. Second, although substantial for this age group, the sample size may be insufficient to detect rare outcomes. Third, follow-up imaging was not systematic, precluding assessment of long-term renal scarring.

Previous data provide some reassurance: Bocquel et al. reported renal sequelae in approximately 30% of infants after UTI, with no difference between exclusive oral therapy and initial IV treatment (4). A 2021 systematic review further suggested that unilateral renal scarring has minimal long-term impact on glomerular filtration rate.

# Conclusion

Our findings support the safety of short-course IV antibiotic course for carefully selected neonates under 28 days with UTI. This approach could significantly reduce hospitalization duration, side effects secondary to intravenous infusions, healthcare costs, and disruption to parent-neonates bonding, while maintaining treatment efficacy. Further prospective studies with larger cohorts and standardized risk stratification are needed to validate these findings and develop guidelines specific to this age group.

# Abbreviations

C-reactive protein (CRP)

Extended-spectrum beta-lactamase (ESBL)

International Classification of Diseases (ICD-10)

Interquartile range (IQR)

Intravenous (IV)

Procalcitonin (PCT)

Respiratory syncytial virus (RSV)

Urinary tract infection (UTI)

Vesicoureteral reflux (VUR)

# Declarations

**Funding Declaration**

The authors received no financial support for the research, authorship, and/or publication of this article

**Conflict of interest**

The author declares that he has no conflict of interest

**Ethics approval**

This study was accepted by the Ethics Committee of the French Pediatric Society, in accordance with the Declaration of Helsinki

## References


1. Greenhow TL, Hung YY, Herz AM, Losada E, Pantell RH (2014) The Changing Epidemiology of Serious Bacterial Infections in Young Infants. Pediatr Infect Dis J juin 33(6):595
2. Ramgopal S, Janofsky S, Zuckerbraun NS, Ramilo O, Mahajan P, Kuppermann N et al (2019) Risk of Serious Bacterial Infection in Infants Aged ≤ 60 Days Presenting to Emergency Departments with a History of Fever Only. J Pediatr 1 janv 204:191–195
3. Spencer JD, Schwaderer A, McHugh K, Hains DS (2010) Pediatric urinary tract infections: an analysis of hospitalizations, charges, and costs in the USA. Pediatr Nephrol Berl Ger déc 25(12):2469–2475
4. Bocquet N, Sergent Alaoui A, Jais JP, Gajdos V, Guigonis V, Lacour B et al (2012) Randomized trial of oral versus sequential IV/oral antibiotic for acute pyelonephritis in children. Pediatr févr 129(2):e269–275
5. Madhi F, Rybak A, Basmaci R, Romain AS, Werner A, Biscardi S et al (2024) Antibiothérapies curatives des infections urinaires de l'enfant. J Pédiatrie Puériculture juin 37(3):150–157
6. SUBCOMMITTEE ON URINARY TRACT INFECTION. Reaffirmation of AAP Clinical Practice Guideline (2016) The Diagnosis and Management of the Initial Urinary Tract Infection in Febrile Infants and Young Children 2–24 Months of Age. Pediatr déc 138(6):e20163026
7. Lewis-de Los Angeles WW, Thurm C, Hersh AL, Shah SS, Smith MJ, Gerber JS et al (2017) Trends in Intravenous Antibiotic Duration for Urinary Tract Infections in Young Infants. Pediatr 1 déc 140(6):e20171021
8. Patil RK, Kabera B, Muia CK, Ale BM (2022) Hospital acquired infections in a private paediatric hospital in Kenya: a retrospective cross-sectional study. Pan Afr Med J 41:28
9. Uddin TM, Chakraborty AJ, Khusro A, Zidan BRM, Mitra S, Emran TB et al (2021) Antibiotic resistance in microbes: History, mechanisms, therapeutic strategies and future prospects. J Infect Public Health déc 14(12):1750–1766
10. Grabert BE, Wardwell C, Harburg SK (1986) Home phototherapy. An alternative to prolonged hospitalization of the full-term, well newborn. Clin Pediatr (Phila) juin 25(6):291–294
11. Hikmat S, Lawrence J, Gwee A (2022) Short Intravenous Antibiotic Courses for Urinary Infections in Young Infants: A Systematic Review. Pediatr 1 févr 149(2):e2021052466
12. Autore G, Bernardi L, La Scola C, Ghidini F, Marchetti F, Pasini A et al (2022) Management of Pediatric Urinary Tract Infections: A Delphi Study. Antibiotics. 18 août. ;11(8):1122
13. Buettcher M, Trueck J, Niederer-Loher A, Heininger U, Agyeman P, Asner S et al (2021) Swiss consensus recommendations on urinary tract infections in children. Eur J Pediatr mars 180(3):663–674

14. Yang SS, Tsai JD, Kanematsu A, Han CH (2021) Asian guidelines for urinary tract infection in children. J Infect Chemother 1 nov 27(11):1543–1554
15. Okarska-Napierała M, Wasilewska A, Kuchar E (2017) Urinary tract infection in children: Diagnosis, treatment, imaging – Comparison of current guidelines. J Pediatr Urol 1 déc 13(6):567–573
16. Zu'bi F, Pokarowski M, Al-Kutbi R, Science M, Vallipuram J, O'Kelly F et al (2023) A Comparison of Short Versus Long Course Intravenous Antibiotics When Treating Urinary Tract Infection in Infants < 60 Days of Age. Clin Pediatr (Phila) oct 62(10):1201–1208
17. Marsh MC, Watson JR, Holton C, Hill N, Saldivar L, Janse S et al (2020) Relationship Between Clinical Factors and Duration of IV Antibiotic Treatment in Neonatal UTI. Hosp Pediatr 1 sept 10(9):743–749
18. Desai S, Aronson PL, Shabanova V, Neuman MI, Balamuth F, Pruitt CM et al (2019) Parenteral Antibiotic Therapy Duration in Young Infants With Bacteremic Urinary Tract Infections. Pediatr sept 144(3):e20183844
19. Liao PF, Ku MS, Tsai JD, Choa YH, Hung TW, Lue KH et al (2014) Comparison of procalcitonin and different guidelines for first febrile urinary tract infection in children by imaging. Pediatr Nephrol sept 29(9):1567–1574

## Table 2

Table 2 is available in the Supplementary Files section.

## Figures

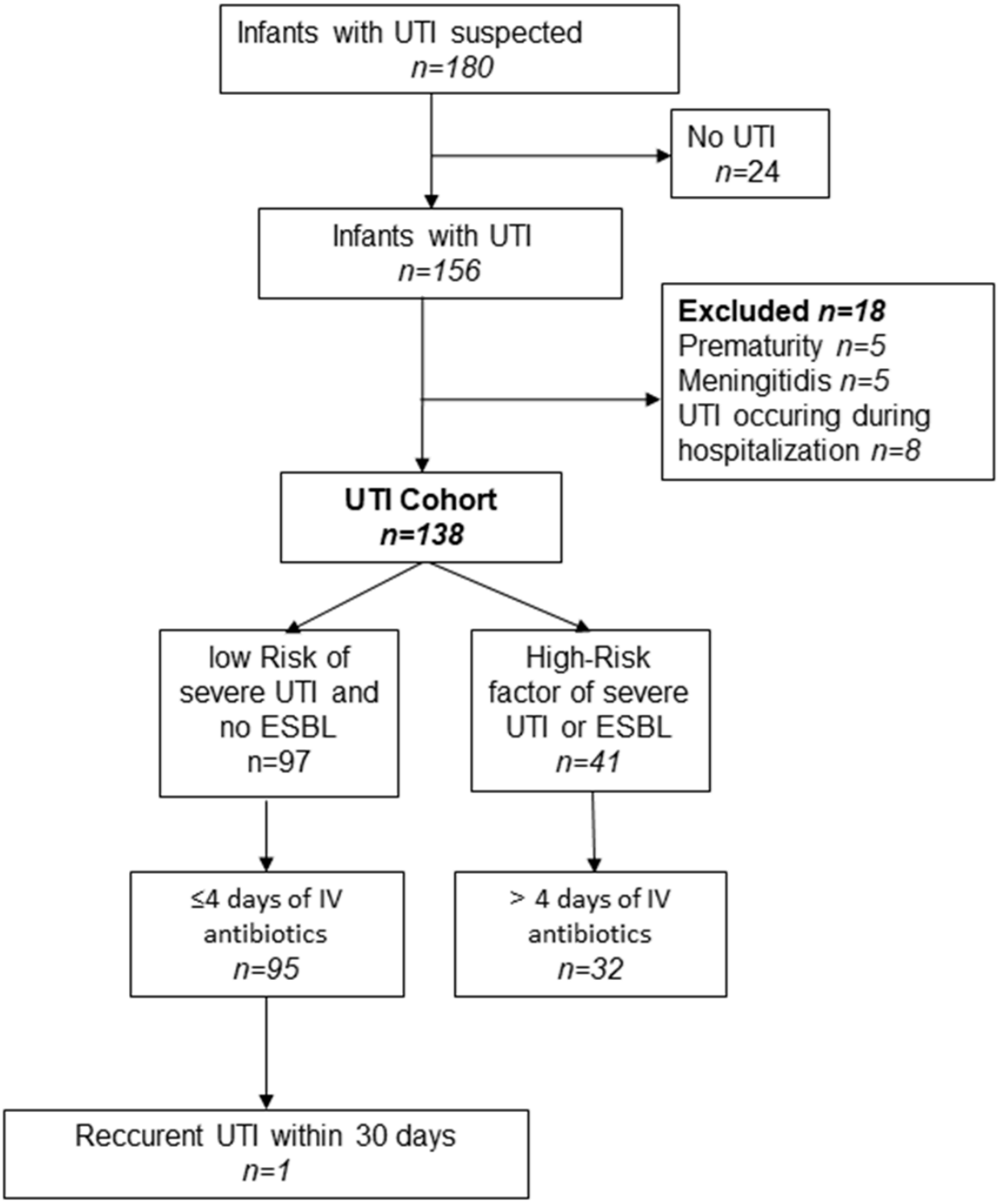



**Figure 1**

Flowchart of patient selection and risk stratification.
UTI: urinary tract infection; ESBL: extended-spectrum beta-lactamase; IV: intravenous.

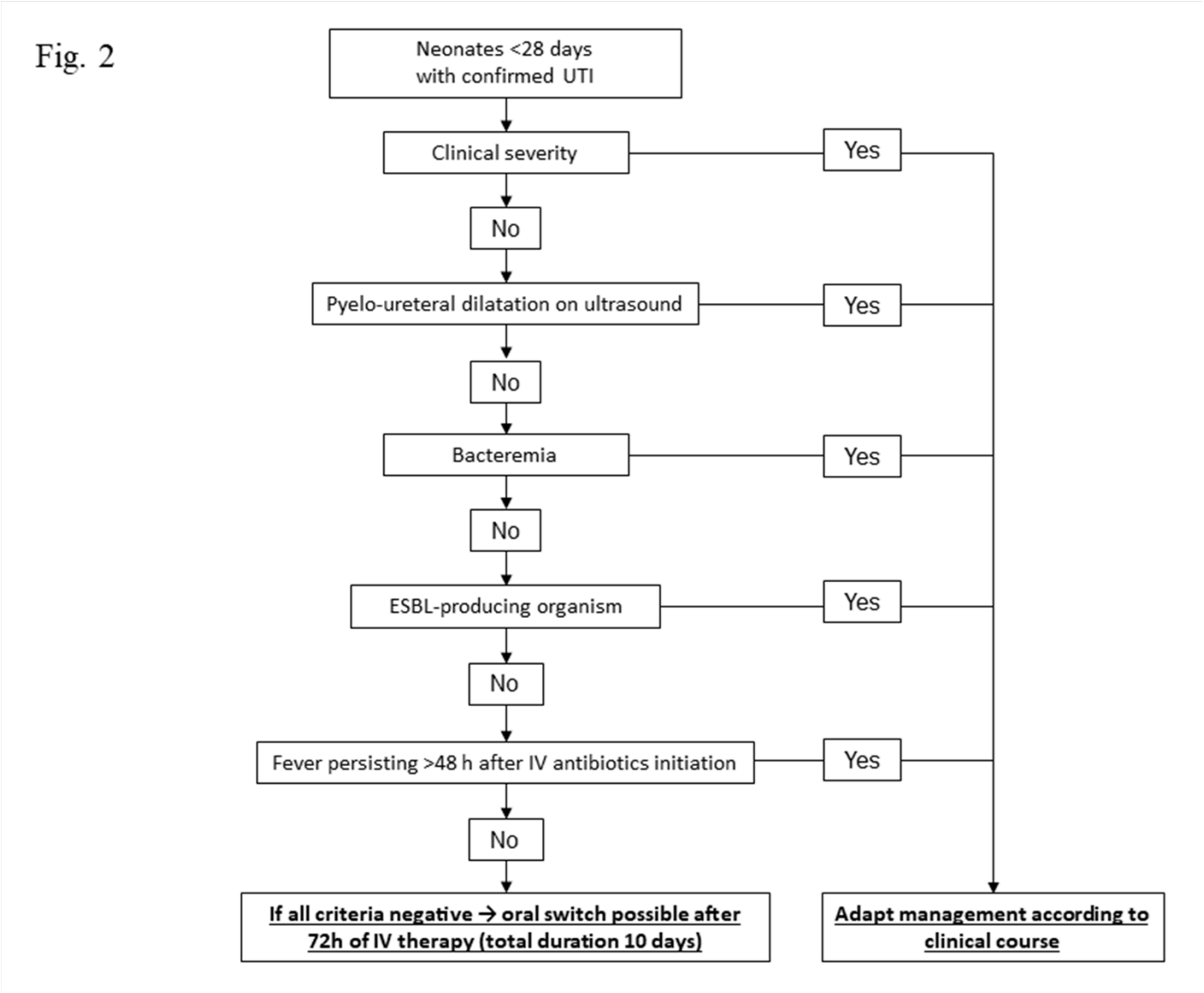



**Figure 2**

Proposed decision algorithm for antibiotic management in neonates under 28 days with urinary tract infection. An oral switch after 72 hours of IV therapy can be considered if all severity criteria are negative: no clinical severity, no pyelo-ureteral dilatation, no bacteremia, no ESBL-producing organism, and resolution of fever within 48 hours.
UTI: urinary tract infection; ESBL: extended-spectrum beta-lactamase; IV: intravenous.

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Table2.docx