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Inpatient Pediatric Nephrology Consultations: Indications, Documented Precontact Information, Consultation Functions, and Institution-Recorded Post-Discharge Nephrology Visits

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Highlights

What are the main findings?

- Inpatient pediatric nephrology consultations served multiple, overlapping functions: new management recommendations or decisions were documented in 41.5% of episodes, diagnostic-test recommendations in 66.9%, and repeat nephrology reviews in 17.8%.
- Outpatient nephrology follow-up was planned in all 115 episodes ending in discharge alive, whereas a post-discharge visit was documented at our institution in 39.1% of these episodes.

What are the implications of the main findings?

- Evaluating inpatient pediatric nephrology consultations solely by changes in clinical management may overlook their diagnostic, reassessment, and follow-up-planning functions. These contributions should be considered when assessing the scope of subspecialty consultation services.
- Differences in documented precontact information across care settings and the limited visibility of post-discharge nephrology visits provide opportunities to evaluate referral communication, documentation practices, and follow-up coordination in future prospective quality-improvement studies.

Abstract

Background/Objectives: Inpatient pediatric nephrology consultations may serve management, diagnostic, reassessment, and follow-up-planning functions. We examined indications, documented precontact information, consultation functions, and post-discharge nephrology visits recorded at the treating institution. **Methods:** This single-center retrospective study included all formal inpatient pediatric nephrology consultation episodes requested in 2023. The primary outcome was a new nephrology-attributable management recommendation or decision absent from the documented precontact plan. **Results:** There were 118 episodes involving 115 patients. Urinary tract infection (26.3%) and electrolyte disturbance (16.1%) were the leading indications. New management recommendations or decisions were documented in 49 episodes (41.5%; 95% CI 33.0–50.5), diagnostic-test recommendations in 79 (66.9%), and repeat reviews in 21 (17.8%). Blood pressure, core biochemistry, and urinalysis were jointly documented before contact in 90.4% of intensive-care and 59.1% of non-intensive-care episodes (absolute difference 31.3 percentage points;

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95% CI 15.7–44.5). Among 115 discharged-alive episodes, follow-up was planned in all, and institutional records identified a post-discharge nephrology visit in 45 (39.1%), no such visit in 56 (48.7%), and indeterminate status in 14 (12.2%). **Conclusions:** Consultations involved functions beyond new management decisions. Precontact information and institution-recorded post-discharge visits are descriptive measures, not indicators of care quality, overall follow-up adherence, or effectiveness.

Keywords: pediatric nephrology; referral and consultation; hospitalization; precontact documentation; outpatient follow-up; health services research

1. Introduction

Pediatric nephrologists support hospitalized children with acute and chronic kidney disease, hypertension, congenital anomalies of the kidney and urinary tract (CAKUT), and fluid or electrolyte disorders [1]. Hospitalizations involving pediatric chronic kidney disease have been associated with longer stays, higher costs, and higher mortality than hospitalizations involving other chronic illnesses, although the authors attributed these differences largely to the greater medical complexity of these hospitalizations [2].

Subspecialty consultation can contribute to diagnostic evaluation and treatment [3]. Consultation use among pediatric hospitalists also varies with patient, physician, and system characteristics [4]. Conversely, unnecessary or inappropriate consultation may contribute to additional testing or delays, although this concern is derived largely from adult perioperative literature [5].

A prospective Jordanian series documented diverse inpatient pediatric nephrology indications and repeated encounters [6]. Much of the published literature on nephrology consultation timing and clinical outcomes concerns adult patients with acute kidney injury (AKI) [7–9]. In pediatric inpatient care, data remain limited on how management and diagnostic recommendations, repeat reviews, and follow-up planning overlap within individual nephrology consultation episodes, what information is documented before specialist contact, and whether post-discharge nephrology visits are captured in institutional records.

We therefore aimed to characterize all formal inpatient pediatric nephrology consultation episodes at our institution over one calendar year, focusing on consultation indications, activity across care settings, documented precontact information, the range and overlap of consultation functions, and the distinction between outpatient follow-up planning and institution-recorded post-discharge nephrology visits.

2. Materials and Methods

2.1. Study Design and Setting

This retrospective observational study included all formal inpatient pediatric nephrology consultation episodes initiated by requests dated 1 January–31 December 2023 for hospitalized children aged 0–18 years at a tertiary referral hospital in Türkiye. Eligible settings were general pediatric wards, neonatal care, the pediatric intensive care unit (PICU), and pediatric subspecialty inpatient services. During the study period, inpatient pediatric nephrology consultations were provided by the institution's sole pediatric nephrologist, who had served in this role since August 2017. Emergency-department-only and outpatient-only encounters were excluded. The decision to undertake this retrospective study was made after the 2023 observation period. All consultations and their contemporaneous documentation had been completed as part of routine clinical care, without a study-specific

research protocol. No quality-improvement intervention or comparator period was included. Reporting followed the STROBE recommendations [10].

Formal requests were identified from the hospital information system and reconciled with clinical documentation. Annual admission denominators were obtained from the hospital statistics unit. For setting-level reporting, neonatal care comprised neonatal intensive care (levels I–II and III–IV) and postnatal rooming-in care for newborns staying with their mothers. Levels I–II and III–IV refer to the institution's neonatal intensive care units; postnatal rooming-in care was not an intensive-care setting. For the exploratory comparison of precontact information, episodes from neonatal intensive care (levels I–IV) or the PICU were classified as intensive-care episodes; those from postnatal rooming-in care, general pediatric wards, or other pediatric subspecialty inpatient services were classified as non-intensive-care episodes. Neonatal intensive care levels were retained separately for service-activity reporting but were combined within the intensive-care group for this exploratory comparison. Verbal advice subsequently formalized through an eligible electronic request was included in the corresponding episode and was not counted as an additional consultation. Advice never formalized in the hospital information system was outside the study population and could not be systematically quantified.

The study was approved by the Eskişehir City Hospital Scientific Research Ethics Committee (decision no. ESH/BAEK 2026/308; 6 January 2026).

2.2. Consultation Episodes and Chronology

The unit of analysis was a formal consultation episode within one hospital admission. Eligibility was determined by the date of the formal request; admissions spanning the calendar-year boundary remained eligible when a request occurred during 2023. Subsequent formal requests or reviews in the same admission were linked to that episode, whereas a new admission constituted a new episode. If a formal request followed earlier nephrology involvement in the same admission, the earliest source-documented nephrology contact was retained as the index contact. The index-contact date was determined primarily from dated clinical notes, followed by attributable orders or interventions and, when necessary, the formal consultation record. Undocumented verbal discussions were not assigned retrospective dates.

Precontact information and the active management plan were assessed relative to the index contact. Admission-to-index-contact intervals were calculated in calendar days (same-day contact = 0) and interpreted as chronology rather than referral delay or response time. Age was calculated at index contact. Study-defined age groups were neonates (<28 days), infants and toddlers (28 days to <2 years), preschool children (2 to <6 years), school-aged children (6 to <12 years), and adolescents (12–18 years). A sensitivity analysis restricted the dataset to each patient's earliest eligible admission to assess whether repeat admissions materially influenced the primary estimate.

2.3. Data Abstraction and Outcomes

All research-specific data abstraction, source-record verification, and outcome classification, including the review of post-discharge nephrology follow-up records, were performed after ethics committee approval. Statistical analyses were also performed after ethics committee approval. Pediatric residents transcribed information from contemporaneous clinical notes, observation charts, consultation records, and laboratory and imaging systems into a standardized data collection form without independently interpreting the clinical findings or assigning study outcomes. The requesting clinician and unit, the responding nephrologist, documented investigations, and nephrology recommendations were identifiable in the contemporaneous electronic records. The pediatric nephrologist who had personally

provided all index consultations then checked every episode against the original electronic records, corrected omissions or transcription errors, and classified the outcomes according to the operational definitions below. This complete source-record verification used contemporaneous documentation, not retrospective recollection of encounters. The process separated data transcription from clinical classification, but no independent or blinded adjudication of study outcomes was performed; consequently, inter-rater agreement could not be assessed. The reviewing nephrologist's familiarity with the consultation workflow and clinical context informed application of these criteria to the original records, particularly in distinguishing newly introduced management recommendations or decisions from plans already documented before the index contact. No formally documented pilot of the coding rules or independent procedure for resolving ambiguous classifications was available.

Variables included patient and episode characteristics, care setting, consultation indication, admission, nephrology-contact and discharge dates, pre-existing kidney or urinary tract disease, nonrenal comorbidity, kidney replacement therapy, and in-hospital death. Pre-existing kidney or urinary tract disease required documentation predating the current admission; newly identified or merely suspected conditions were not classified as pre-existing. Nonrenal comorbidity excluded kidney and urinary tract disorders and acute index-admission diagnoses and was summarized in nonexclusive groups (Supplementary Table S1). Past medical and family history records were reviewed for all patients, irrespective of age. Prematurity/perinatal comorbidity was coded according to the information documented in these records. Requesting and nephrology assessments were classified as concordant when the principal kidney or urinary tract problem was retained; partially concordant when a component was retained but another was added, excluded, or materially revised; and discordant when the suspected disorder was not confirmed or the principal nephrology assessment differed.

The primary outcome was a new nephrology-attributable management recommendation or decision absent from the documented active plan before the index contact. A management recommendation was an actionable instruction proposed by nephrology; a management decision was a newly documented clinical management determination, including a decision to change treatment, institute monitoring with an action threshold, or transfer care. Qualifying types included initiation, discontinuation, or modification of medication; specified fluid, electrolyte, blood pressure (BP), or kidney replacement therapy plans; transfer-of-care decisions; and other actionable kidney-related management choices. Types were nonexclusive. Recommendations had to be attributable to nephrology. Continuation of an unchanged plan, a diagnostic-test recommendation alone, repeat review alone, or follow-up planning alone did not fulfill the primary outcome. Conditional recommendations qualified only when an explicit trigger was linked to a specified action. Implementation or completion of the recommended management plan was assessed separately at the consultation-episode level, based on documented performance of the recommended action or prescribed monitoring. This episode-level assessment did not establish completion of every individual recommendation within overlapping types. If a conditional treatment threshold was not reached, completion of the specified monitoring counted as plan completion, not treatment initiation. These measures did not assess clinical effectiveness or determine whether an unchanged plan had been explicitly confirmed as appropriate.

Outpatient nephrology follow-up planning was recorded separately from subsequent post-discharge visits. Follow-up planning and post-discharge visits were assessed for episodes ending in discharge alive and were considered not applicable after in-hospital death. Attendance ascertainment was restricted to pediatric nephrology visits identifiable in the treating institution's records after hospital discharge. A visit found in those records

was classified as institution-recorded attendance; absence of such a visit in evaluable institutional records was described as no institution-recorded visit; and episodes for which the records did not permit reliable classification were retained as indeterminate. These labels concern the available institutional records and cannot distinguish care at another center from no outpatient care. The study was not designed to evaluate adherence to individually recommended appointment intervals or clinical outcomes of follow-up. Indeterminate ascertainment comprised newborns hospitalized under maternal or provisional identifiers whose subsequently issued permanent identifiers were not available to the study team, so that later outpatient records could not be linked; these episodes were not reclassified as evidence of nonattendance. The treating institution's pediatric nephrology outpatient records were retrospectively searched in 2026, after ethics committee approval on 6 January 2026, for visits following discharge from the 2023 consultation cohort. No fixed post-discharge observation window was prespecified, and the exact date of the final institutional record search could not be confirmed. Because the latest discharge occurred on 30 January 2024 and the search was performed after 6 January 2026, every discharged-alive episode had at least 23 months of potential institutional observation. When the date of the first institution-recorded visit was available, the discharge-to-visit interval was calculated in calendar days from the discharge date, derived from the admission date and length of stay. No standardized episode-specific rule for linking outpatient visits to consultation episodes was available; the recorded proportions therefore describe institution-recorded visits over variable observation periods rather than fixed-window attendance.

2.4. Precontact Information and Consultation Functions

Precontact information was defined as data retrievable from the current admission record before index nephrology contact. Domains assessed overall were at least one recorded BP measurement, a core biochemical panel comprising blood urea nitrogen, creatinine, sodium, potassium, and calcium, urinalysis, and renal ultrasonography. The availability of each of the biochemical components before the index nephrology contact was assessed individually using the hospital information system. The core biochemical panel was considered available only when all five components were documented. Availability denotes information documented before contact, rather than clinical completeness or necessity of testing. BP documentation, core biochemistry, and urinalysis were combined as a study-defined joint basic precontact information measure. This descriptive composite was neither a validated readiness score nor a universal prerequisite for consultation; renal ultrasonography was kept separate because its use depends on indication, age, and clinical context [11,12].

Blood pressure documentation was assessed at two levels. For all consultation episodes, the availability of at least one documented BP measurement before nephrology contact was recorded as part of the joint basic precontact information measure. For episodes referred for suspected hypertension, the availability of at least three separate precontact BP measurements was additionally recorded as a study-defined indicator of repeated assessment. This three-measurement threshold was not used as a diagnostic criterion for hypertension or as a measure of guideline adherence. Pediatric hypertension guidance recommends that when an initial office BP measurement is elevated, two additional measurements should be obtained at the same visit and averaged to determine the BP category [13].

Indication-specific precontact components included urine culture for urinary tract infection (UTI) [11]; serum creatinine and urine-output assessment for AKI [14]; quantitative proteinuria and serum albumin for proteinuric or glomerular presentations [15]; and electrolyte, acid-base, or urine indices when appropriate, particularly for suspected salt-losing tubulopathies [16]. Renal imaging was considered in the context of guidance on UTI and urinary tract dilation [11,12]. The cited clinical guidance and consensus literature informed

the selection of potentially relevant precontact data elements for descriptive assessment; these references were not applied as mandatory investigation requirements across all ages, indications, or care settings. The absence of a retrievable precontact result did not establish whether a test had been ordered, was pending, or was clinically indicated, and was not considered evidence of an inadequate evaluation. Laboratory and imaging recommendations were counted separately and jointly as any diagnostic-test recommendation. Repeat review was a subsequent documented nephrology assessment in the same admission. The four study-defined, nonexclusive consultation functions were a new management recommendation or decision, a diagnostic-test recommendation, repeat review, and outpatient follow-up planning; they were not combined into a composite measure of clinical effectiveness.

2.5. Statistical Analysis

This fixed-year cohort included all eligible formal consultation episodes, so no a priori sample-size calculation was performed. Analyses were primarily episode-based. Categorical variables were summarized as counts and percentages and continuous variables as medians (interquartile ranges [IQRs] and ranges). Absence of a precontact test or measurement was itself an observed documentation category, not a missing analytic value. Indeterminate and non-applicable follow-up or consultation observations were retained separately rather than coded as negative findings. Two-sided 95% confidence intervals (CIs) for selected proportions were calculated using the Wilson score method without continuity correction.

Consultation-episode rates per 100 admissions were calculated for care settings with corresponding annual admission denominators as the number of eligible episodes requested during 2023 divided by the corresponding annual admission denominator and multiplied by 100. Because patients could contribute episodes from separate admissions and one eligible episode arose from an admission beginning in 2022, these are descriptive annual service-activity rates rather than patient incidence estimates or individually independent probabilities of consultation. They are not case-mix-adjusted comparisons or measures of consultation effectiveness.

The primary analysis included all eligible episodes. The earliest eligible admission per patient was also analyzed to assess the influence of repeat admissions on the primary outcome. New management recommendations or decisions were tabulated by nonexclusive type, indication, and care setting; diagnostic-test recommendations and repeat reviews were summarized separately. Overlap of the four consultation functions was cross-tabulated descriptively. Exploratory secondary analyses compared the availability of joint basic precontact information by intensive-care status and described institution-recorded follow-up by pre-existing kidney or urinary tract disease. Follow-up subgroup comparisons included only discharged-alive episodes with ascertainable institutional attendance; indeterminate episodes were kept separate. All indication- and setting-specific estimates were exploratory and unadjusted. For follow-up, a supplementary patient-level sensitivity analysis retained only the earliest eligible admission per patient and excluded in-hospital deaths. Discharge-to-visit intervals were summarized as medians (IQRs and ranges) for visit-positive episodes with an available visit date. Because some visit dates were unavailable, the numbers of episodes with an institution-recorded visit within 90 days and within 12 months of discharge were reported as lower and upper bounds.

For selected exploratory contrasts, absolute differences in proportions were reported with 95% CIs computed by the Newcombe method from Wilson score intervals without continuity correction. No formal null-hypothesis testing or multivariable modelling was undertaken given the descriptive aims, sparse subgroups, heterogeneous case mix, and absence of standardized severity measures. No analysis of the clinical effects of consultation

was attempted because a non-consulted comparison group was unavailable. Estimates were interpreted descriptively. Descriptive analyses, cross-tabulations, and confidence intervals were calculated in Microsoft Excel for Microsoft 365 (Microsoft Corp., Redmond, WA, USA) using explicit spreadsheet formulas. The episode-level binomial CIs assume independent observations and do not adjust for repeated admissions.

3. Results

3.1. Cohort and Care Settings

All included episodes had a formal electronic consultation request and a documented response from the same pediatric nephrologist. The 118 consultation episodes represented 115 unique patients; three were repeat-admission episodes. Male sex was recorded in 66 episodes (55.9%), the median age at index contact was 0.87 years (IQR 0.07–9.67), and pre-existing kidney or urinary tract disease was present in 19 episodes (16.1%), involving 18 patients. At least one pre-existing nonrenal comorbidity was documented in 31 episodes (26.3%). The median length of stay was 7 days (IQR 4–15), and the median admission-to-index-contact interval was 2 calendar days (IQR 1–5) (Table 1; Supplementary Materials, Table S1).

Table 1. Patient and consultation-episode characteristics (N = 118 consultation episodes).

Characteristic	Value
Unique patients represented	115
Repeat-admission episodes, *n* (%)	3 (2.5)
Male sex, *n* (%)	66 (55.9)
Age at index contact, years; median (IQR; range)	0.87 (0.07–9.67; 0.00–17.70)
Age group at index contact, *n* (%)	
Neonates (<28 days)	33 (28.0)
Infants and toddlers (28 days to <2 years)	32 (27.1)
Preschool children (2 to <6 years)	14 (11.9)
School-aged children (6 to <12 years)	18 (15.3)
Adolescents (12–18 years)	21 (17.8)
At least one pre-existing nonrenal comorbidity, *n* (%)	31 (26.3)
Pre-existing kidney or urinary tract disease, *n* (%) [a]	19 (16.1)
Length of stay, days; median (IQR; range)	7 (4–15; 1–203)
Admission-to-index nephrology contact, calendar days; median (IQR; range)	2 (1–5; 0–75)

IQR, interquartile range; CAKUT, congenital anomalies of the kidney and urinary tract; CKD, chronic kidney disease. [a] The 19 episodes represented 18 patients and comprised structural kidney or urinary tract disease, including CAKUT (n = 15), nephrotic syndrome (n = 2), CKD (n = 1), and nephrolithiasis (n = 1). Conditions first identified during the index admission were excluded.

General pediatric wards contributed 55 episodes, neonatal care 45 (40 from neonatal intensive care and five from postnatal rooming-in care), PICU 12, pediatric urology 3, pediatric hematology 2, and pediatric rheumatology 1. The corresponding unadjusted annual consultation-episode rates per 100 admissions were 1.82 for general pediatric wards, 3.23 for neonatal intensive care, 8.45 for the PICU, 2.11 for pediatric urology, 1.37 for pediatric

hematology, and 3.70 for pediatric rheumatology. Within neonatal intensive care, the rates were 1.69 per 100 admissions for level I–II care and 8.33 for level III–IV care (Table 2).

Table 2. Consultation episodes and annual service-activity rates by care setting ($N = 118$).

Setting	Consultation Episodes, *n* (%)	2023 Admissions, *n*	Rate per 100 Admissions
General pediatric wards	55 (46.6)	3015	1.82
Neonatal care, all settings *	45 (38.1)	-	-
Neonatal intensive care, total	40 (33.9)	1237	3.23
Level I–II	16 (13.6)	949	1.69
Level III–IV	24 (20.3)	288	8.33
Postnatal rooming-in care	5 (4.2)	-	-
PICU	12 (10.2)	142	8.45
Pediatric urology	3 (2.5)	142	2.11
Pediatric hematology	2 (1.7)	146	1.37
Pediatric rheumatology	1 (0.8)	27	3.70

PICU, pediatric intensive care unit; -, admission denominator not reported or rate not calculated, as applicable. * Of the 45 neonatal consultation episodes, 40 originated from neonatal intensive care (levels I–IV) and five from postnatal rooming-in care. Consultation rates for neonatal care were calculated only for the intensive-care group, using the corresponding annual admission denominators.

3.2. Indications and Precontact Information

The leading consultation indications were UTI in 31 episodes (26.3%), electrolyte disturbance in 19 (16.1%), incidental imaging findings in 16 (13.6%), suspected hypertension in 15 (12.7%), antenatal hydronephrosis/CAKUT in 10 (8.5%), and AKI/abnormal kidney function in 7 (5.9%). Requesting and nephrology assessments were concordant in 99 episodes (83.9%), partially concordant in 3 (2.5%), and discordant in 16 (13.6%). Among the 16 discordant episodes, the suspected kidney or urinary tract diagnosis was not confirmed in 15, and an alternative kidney or urinary tract diagnosis was assigned in one.

Before nephrology contact, the core biochemical panel was recorded as available in 113 episodes (95.8%), urinalysis in 101 (85.6%), renal ultrasonography in 74 (62.7%), and at least one BP measurement in 100 (84.7%). All 15 referrals for suspected hypertension had at least three separate precontact BP measurements. None of the 18 episodes without a documented precontact BP measurement was referred for suspected hypertension. The 18 episodes without a documented precontact BP measurement were from general pediatric wards ($n = 11$), postnatal rooming-in care ($n = 4$), and pediatric urology ($n = 3$). By age group, these comprised neonates ($n = 4$), infants and toddlers ($n = 6$), preschool children ($n = 2$), school-aged children ($n = 3$), and adolescents ($n = 3$). The most frequent indications were UTI ($n = 8$) and incidental imaging findings ($n = 4$).

For the exploratory setting comparison, 52 episodes (40 neonatal intensive care and 12 PICU) were classified as intensive-care and 66 (55 general pediatric wards, 6 pediatric subspecialty services, and 5 postnatal rooming-in care) as non-intensive-care. At least one BP measurement, core biochemistry, and urinalysis were jointly available in 86 episodes (72.9%) overall. At least one BP measurement was available in all 52 intensive-care episodes and in 48 of 66 non-intensive-care episodes (72.7%); core biochemistry was available in all 52 intensive-care episodes and in 61 of 66 non-intensive-care episodes (92.4%); and urinalysis was available in 47 of 52 (90.4%) and 54 of 66 (81.8%), respectively. All three components were jointly available in 47 of 52 intensive-care episodes (90.4%) versus 39 of

66 non-intensive-care episodes (59.1%), an absolute difference of 31.3 percentage points (95% CI 15.7–44.5).

All 31 UTI episodes had precontact urinalysis and urine culture, and renal ultrasonography was available in 24 (77.4%). All seven AKI/abnormal-kidney-function episodes had precontact serum creatinine and a documented urine-output assessment. In five nephrotic/proteinuric presentations, serum albumin was available in all five, whereas a quantitative proteinuria result was retrievable before nephrology contact in one (20.0%) (Supplementary Table S2). The latter proportion does not distinguish a test pending at first contact from a test not requested.

3.3. Management and Diagnostic Recommendations

New nephrology-attributable management recommendations or decisions were documented in 49 episodes (41.5%; 95% CI 33.0–50.5). The study-defined episode-level criterion for documented management-plan completion was met in all 49 episodes. In two conditional antihypertensive plans, specified monitoring was completed, but the treatment-initiation threshold was not reached. In the earliest-admission-per-patient sensitivity analysis, 47 of 115 earliest eligible admission episodes had a new management recommendation or decision (40.9%; 95% CI 32.3–50.0). Recommendation types and indication-specific distributions are presented in Tables 3 and 4, and the sensitivity analysis in Table 5.

Table 3. Types of new nephrology-attributable management recommendations or decisions (n = 49 episodes).

Recommendation/Decision Type	*n* (%) [a]
Medication initiation, discontinuation, or regimen modification	30 (61.2)
Fluid or electrolyte management	27 (55.1)
Blood pressure management	11 (22.4)
Kidney replacement therapy decision or initiation	2 (4.1)
Formal transfer of care to the pediatric nephrology service	1 (2.0)
Other actionable kidney or urinary tract management	6 (12.2)

[a] Categories are nonexclusive; percentages use the 49 episodes with a new management recommendation or decision as the denominator and therefore sum to more than 100%.

Table 4. New management recommendations or decisions by leading consultation indication (N = 118 episodes).

Requesting Indication	All Episodes, *n* (%)	New Management Recommendation or Decision, *n* (% Within Indication)	95% CI
UTI/recurrent UTI	31 (26.3)	11 (35.5)	21.1–53.1
Electrolyte disturbance	19 (16.1)	15 (78.9)	56.7–91.5
Incidental imaging finding	16 (13.6)	3 (18.8)	6.6–43.0
Suspected hypertension	15 (12.7)	10 (66.7)	41.7–84.8
Antenatal hydronephrosis/CAKUT	10 (8.5)	0 (0.0)	0.0–27.8
AKI/abnormal kidney function	7 (5.9)	2 (28.6)	8.2–64.1
Other or low-frequency indications [a]	20 (16.9)	8 (40.0)	21.9–61.3

AKI, acute kidney injury; CAKUT, congenital anomalies of the kidney and urinary tract; CI, confidence interval; UTI, urinary tract infection. [a] The 'Other or low-frequency indications' category combines heterogeneous indications; its aggregate proportion is descriptive and does not represent a clinically homogeneous subgroup.

Table 5. Documented consultation functions, episode-level plan completion, specialist contacts, and institution-recorded post-discharge nephrology visits ($N = 118$ consultation episodes).

Measure	*n* (%) or Count	95% CI
New nephrology-attributable management recommendation or decision	49 (41.5)	33.0–50.5
Earliest-admission-per-patient sensitivity analysis [a]	47 (40.9)	32.3–50.0
Documented episode-level management-plan completion [b]	49 (100.0)	92.7–100.0
Laboratory-related recommendation	55 (46.6)	37.9–55.6
Imaging recommendation	50 (42.4)	33.8–51.4
Any diagnostic-test recommendation (laboratory or imaging)	79 (66.9)	58.0–74.8
Same-admission repeat nephrology review	21 (17.8)	11.9–25.7
Additional same-admission nephrology contacts	33	-
Total nephrology contacts, including index contacts	151	-
Outpatient pediatric nephrology follow-up planned [c]	115 (100.0)	96.8–100.0
Follow-up planned despite neither a new management recommendation/decision nor a diagnostic-test recommendation [d]	25 (100.0)	86.7–100.0
Institution-recorded post-discharge nephrology visit [c]	45 (39.1)	30.7–48.3
No institution-recorded post-discharge nephrology visit [c]	56 (48.7)	39.8–57.7
Indeterminate institutional follow-up ascertainment [c]	14 (12.2)	7.4–19.4

CI, confidence interval. Unless otherwise indicated, percentages use 118 consultation episodes as the denominator. Laboratory-related and imaging recommendations were nonexclusive. [a] Denominator: 115 earliest eligible admissions, one per patient. [b] Denominator: 49 episodes with a new management recommendation or decision; completion was coded at the episode-plan level, with monitoring counted for conditional plans when the treatment threshold was not reached. [c] Denominator: 115 episodes ending in discharge alive. Visit status refers only to the treating institution's records and is not a measure of attendance at other centers. [d] Denominator: 25 episodes with neither a new management recommendation/decision nor a diagnostic-test recommendation.

Among the three largest care settings, new management recommendations or decisions occurred in 23 of 55 general pediatric episodes (41.8%), 13 of 45 neonatal-care episodes (28.9%), and 8 of 12 PICU episodes (66.7%).

Laboratory-related recommendations were documented in 55 episodes (46.6%) and imaging recommendations in 50 (42.4%); at least one laboratory or imaging recommendation was documented in 79 episodes (66.9%; 95% CI 58.0–74.8) (Table 5). Among the 10 antenatal hydronephrosis/CAKUT episodes, none had a new management recommendation or decision, whereas all 10 had a diagnostic-test recommendation, including an imaging recommendation in nine (ultrasonography in seven, one with Doppler examination, and dimercaptosuccinic acid (DMSA) scintigraphy in two), and all 10 had outpatient follow-up planned.

3.4. Repeat Review, Follow-Up, and Overlap

Repeat review occurred in 21 episodes (17.8%; 95% CI 11.9–25.7), generating 33 additional nephrology contacts. Including the 118 index contacts, a total of 151 nephrology contacts were documented. Nine general pediatric, 7 neonatal-care, and 5 PICU episodes generated 10, 10, and 13 additional contacts, respectively.

Outpatient pediatric nephrology follow-up was planned in all 115 episodes ending in discharge alive (100.0%; 95% CI 96.8–100.0) and was not applicable to the three in-hospital deaths. These included all 25 episodes with neither a new management recommendation/decision nor a diagnostic-test recommendation. Twelve episodes had all four study-defined consultation functions, 28 had three, 54 had two, and 24 had one (Supplementary Table S3).

Three episodes ended in in-hospital death. Among 115 episodes ending in discharge alive, a post-discharge nephrology visit was recorded at our institution in 45 (39.1%; 95% CI 30.7–48.3); no such institution-recorded visit was found in 56 (48.7%; 95% CI 39.8–57.7), and ascertainment was indeterminate in 14 (12.2%; 95% CI 7.4–19.4). The post-discharge visit categories were derived from the institutional record search performed in 2026 after ethics committee approval. All 14 episodes with indeterminate institutional follow-up ascertainment originated from neonatal care (11 from neonatal intensive care and three from postnatal rooming-in care). A visit date was available for 36 of the 45 visit-positive episodes; among these, the median discharge-to-visit interval was 21 days (IQR 11–95; range 2–816). An institution-recorded visit within 90 days of discharge was identified in at least 25 and at most 34 of the 115 discharged-alive episodes, and within 12 months in at least 31 and at most 40; the upper bounds assume that all nine undated visits occurred within the respective window. Among 101 episodes with ascertainable institutional status, a visit was recorded in 13 of 18 episodes (72.2%) with pre-existing kidney or urinary tract disease and in 32 of 83 (38.6%) without pre-existing disease, a descriptive difference of 33.7 percentage points (95% CI 8.2–51.8).

In the earliest-admission-per-patient sensitivity analysis, 112 patients survived to discharge. An institution-recorded post-discharge nephrology visit was identified in 45 (40.2%), no such visit was identified in 53 (47.3%), and ascertainment was indeterminate in 14 (12.5%). Among patients with repeat admissions, none had more than one consultation episode classified as having an institution-recorded post-discharge nephrology visit. The three repeat-admission episodes were contributed by two patients. In one of these patients, the recorded visit date fell between the first discharge and the subsequent admission, consistent with attribution to the first episode; in the other, the visit date was not recorded, so attribution could not be confirmed by date.

4. Discussion

Four overlapping functions were recorded in this cohort: new management recommendations or decisions (41.5%), diagnostic-test recommendations (66.9%), repeat review (17.8%), and outpatient follow-up planning (in all 115 episodes ending in discharge alive). Defining the consultation solely by a new inpatient management recommendation or decision would therefore omit several documented activities. In particular, all 25 episodes with neither a new management recommendation or decision nor a diagnostic-test recommendation nevertheless had a follow-up plan. A consultant may confirm an existing plan, recommend observation instead of escalation, or help avoid an unnecessary intervention without adding a new treatment; these possible functions were not systematically coded and cannot be quantified here. Accordingly, the absence of a new management recommendation must not be equated with an unnecessary or valueless consultation. The present outcomes describe documented processes, not clinical benefit.

This multidimensional role is consistent with the acute, chronic, and coordinated-care responsibilities of pediatric nephrology [1]. A PICU study also documented diagnostic-test recommendations and changes in management after subspecialty consultation [3]. Our attribution rule distinguished new management recommendations or decisions attributable to nephrology from plans already documented before contact; it did not establish the causal impact of consultation on health outcomes. Similarly, the reported episode-level completion of management plans does not establish either item-by-item implementation or clinical efficacy.

New management recommendations or decisions varied across indications and care settings, but these proportions are not measures of consultation value. The 0/10 estimate for antenatal hydronephrosis/CAKUT reflects the narrowly defined new inpatient man-

agement outcome, not absence of assessment or follow-up planning; these consultations may appropriately emphasize postnatal imaging decisions and longitudinal surveillance, particularly when urinary tract dilation is present [12]. Consistent with this role, nine of the ten episodes received an imaging recommendation and all had follow-up planned, although the appropriateness of individual imaging decisions was not assessed. The higher unadjusted proportion in PICU episodes may reflect differences in illness acuity and case mix, which could not be accounted for in this analysis. Consultation use is itself shaped by patient, physician, and system factors [4].

BP, core biochemistry, and urinalysis were jointly documented before contact in 90.4% of intensive-care and 59.1% of non-intensive-care episodes. Because availability was assessed before the index nephrology contact rather than at the time of the formal request, these proportions do not establish what information was included in the consultation request itself. This is a difference in recorded information availability, not evidence of superior requesting-clinician performance or consultation quality in intensive care. Differences in monitoring routines, laboratory sampling, age, consultation indications, and illness acuity may contribute to the observed pattern, but this unadjusted comparison cannot determine whether care setting independently accounts for the difference. A locally adapted referral-information prompt could record whether particular measurements are present, pending, or clinically not indicated, without mandating indiscriminate testing or delaying an urgent consultation.

Blood pressure is a routine vital-sign domain in pediatric inpatient care, but its indication-specific timing and frequency were not evaluated here. All suspected-hypertension consultations had serial precontact measurements, whereas 18 other episodes lacked a retrievable precontact BP measurement; these 18 arose in non-intensive-care settings. Pediatric guidance distinguishes repeat office measurements after an elevated value from longitudinal diagnostic confirmation [13]. The present finding describes recorded precontact information, not a demonstrated failure to meet a universal inpatient BP standard or an assessment of the clinical appropriateness of each omitted measurement. In a selected cohort of hospitalized children prescribed as-needed antihypertensive medication, elevated BP was frequently unrecognized [17].

Outpatient follow-up planning and institution-recorded post-discharge visits were assessed as distinct measures. Follow-up was planned in all episodes ending in discharge alive, but a nephrology visit after discharge was identified in our institution's records for 39.1% of episodes ending in discharge alive. Among visits with an available date, the median discharge-to-visit interval was 21 days, but the distribution was wide. This proportion describes visits documented at the treating institution within the available record system, not adherence to recommended follow-up or overall nephrology access. Children may have received nephrology care at other institutions, which our records could not capture; therefore, the absence of an institution-recorded visit should not be interpreted as failure to attend follow-up. Pediatric AKI research similarly illustrates differences between recognition, consultation, and recorded outpatient follow-up [18]. In exploratory comparisons, locally recorded visits were more frequent among episodes with pre-existing kidney or urinary tract disease than among those without pre-existing disease (72.2% vs. 38.6% among episodes with ascertainable institutional follow-up status). Chronicity, families' established care pathways, and perceived follow-up need may contribute, but the small, heterogeneous groups and unmeasured follow-up opportunities preclude causal interpretation. Pediatric hospital-medicine literature has emphasized the context-dependent value of subspecialty consultation [19], and qualitative research has identified facilitating longer-term specialist follow-up as one reason for requesting consultation [20].

Repeat review is best interpreted as documented specialist activity and contact frequency, not effectiveness. Twenty-one episodes generated 33 additional contacts. Recording repeats within episodes avoids treating each review as a separate consultation episode. Informal advice that never became a formal request was not counted and may add to the service workload. Similarly, admission-to-contact intervals provide chronology, not proof of referral delay. Adult studies have examined both nephrology consultation in established AKI and structured early consultation among patients at risk of AKI [7–9]. In a randomized trial of adults at risk for AKI, structured early consultation generated additional recommendations but did not improve the primary outcome of peak serum creatinine change over seven days [7]. These findings cannot be directly generalized to pediatric inpatient nephrology consultations.

Strengths include complete ascertainment of formal inpatient nephrology requests during an entire calendar year, a consistent episode definition, source-based chronology, and separate documentation of four overlapping consultation functions. The same pediatric nephrologist performed all consultations, minimizing between-consultant variation in clinical approach within this service; the clinician's subsequent verification of every episode against contemporaneous records also allowed discrepancies in the initial transcription to be corrected. These features support consistency of the source-data review. This context-informed verification may have facilitated consistent classification of new versus pre-existing management plans, although its reproducibility was not evaluated by independent reviewers. Because the study was conceived after the observation period, consultations and their documentation were not undertaken in anticipation of research, reducing the potential for study-related changes in clinical behavior. The earliest-admission-per-patient sensitivity analysis addressed the small number of repeat episodes for the primary estimate. The operational framework may be evaluated for use in other inpatient pediatric subspecialty services, even though the observed proportions are specific to this hospital.

Several limitations require emphasis. This retrospective, single-center description depends on documentation and cannot identify informal advice without a formal request. Although pediatric residents transcribed source data without interpretation and the consulting nephrologist checked each episode, outcome classification was not independently adjudicated; familiarity with the clinical encounters could influence classification. Recorded follow-up was limited to the treating institution, and the analysis did not evaluate timeliness relative to individualized recommended intervals or care received elsewhere. Differences in the opportunity to observe follow-up, uncertain status in 14 episodes, and repeated admissions also limit interpretation of episode-level follow-up proportions and CIs. Excluding episodes with indeterminate follow-up status from subgroup comparisons may also introduce selection bias. All indeterminate episodes involved newborns hospitalized under maternal or provisional identifiers whose subsequently issued permanent identifiers were not available to the study team, which prevented linkage to later outpatient records. Additionally, 13 neonatal-care episodes were classified as having no institution-recorded visit and may be vulnerable to the same ascertainment limitation. Together with visits occurring outside our institution, these neonatal record-linkage limitations may lead to underascertainment of post-discharge follow-up; the observed visit proportion therefore cannot be interpreted as overall attendance. Small heterogeneous subgroups, lack of standardized acuity data, and the absence of a non-consulted comparator preclude attribution of outcomes to consultation or adjusted setting-quality comparisons. The single-consultant design reduces within-center clinical heterogeneity but limits generalizability to multi-consultant services, different referral thresholds, and other record systems. Finally, one formal request in 2023 arose from an admission beginning in 2022, so setting-level rates are annual service-activity measures rather than strict incidence estimates. The post-discharge institutional record

review was conducted in 2026 after ethics committee approval, rather than prospectively during the 2023 care period. Although this allowed time for later institutional visits to be recorded, the observation intervals from discharge were not standardized. These data cannot establish whether children returned at the recommended time or received follow-up outside our institution. A date for the first institution-recorded visit was unavailable for 9 of the 45 visit-positive episodes, so discharge-to-visit intervals were incomplete and fixed-window estimates could be reported only as bounds.

These observations suggest two domains for prospective evaluation: the documentation and communication of clinically appropriate information before nephrology contact, and the coordination and ascertainment of post-discharge nephrology follow-up. Locally agreed, indication-sensitive referral-information prompts and structured follow-up pathways could be evaluated using prespecified process measures, without mandating unnecessary testing or delaying urgent specialist involvement. The present findings do not establish deficiencies in individual clinical decisions or demonstrate that any particular intervention would improve care. Multicenter studies with different staffing and record systems could examine the transferability of the consultation-function categories and whether process changes translate into patient-centered outcomes.

5. Conclusions

In this one-year cohort, formal inpatient pediatric nephrology consultation included overlapping management, diagnostic, repeat-review, and follow-up-planning functions. New management recommendations or decisions represented only one aspect of documented consultation activity. Documented management-plan completion was assessed at the episode level and did not establish item-by-item implementation of all recommendations. Precontact information availability differed across care settings, while outpatient follow-up planning was not consistently accompanied by a post-discharge nephrology visit identifiable in institutional records. These descriptive measures should not be interpreted as comparative care quality, overall follow-up adherence, or clinical effectiveness. They may inform locally tailored, prospective assessment of precontact information practices and follow-up coordination.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/children13121631/s1, Table S1, Age-specific pre-existing nonrenal comorbidity categories; Table S2, Precontact information availability overall and for selected consultation indications; Table S3, Overlap of study-defined consultation functions in the final dataset.

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Data Availability Statement: The data presented in this study are available from the corresponding author upon reasonable request. The data are not publicly available because they derive from individual patient clinical records and are subject to institutional and ethical privacy restrictions.

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