Supplementary Online Content

Yang S, Gill PJ, Anwar MR, et al; Canadian Paediatric Inpatient Research Network (PIRN). Kidney ultrasonography after first febrile urinary tract infection in children: a systematic review and meta-analysis. *JAMA Pediatr*. Published online May 30, 2023. doi:10.1001/jamapediatrics.2023.1387

This supplementary material has been provided by the authors to give readers additional information about their work.

eMethods

Search Strategy

Appendix 1. Search Strategy

MEDLINE (Ovid)

1. exp Urinary Tract Infections/
2. (urinary tract infection? or UTI or UTIs).tw,kf.
3. or/1-2
4. infant/ or exp infant, newborn/
5. Child, Preschool/
6. (babies or baby or infan* or neonat* or neo-nat* or newborn* or new-born* or paediatric* or peadiatric* or pediatric* or toddler?).tw,kf.
7. (pediatric* or paediatric* or infan* or child*).jn,jw. or (pediatric* or paediatric* or infan* or child*).in.
8. or/4-7
9. exp Ultrasonography/
10. (renal adj5 (echograph* or echotomograph* or medical sonograph* or ultrasonic diagnos* or ultrasonic imag* or ultrasonic tomograph* or ultrasonographic imag* or ultrasonograph* or ultrasound?)).tw,kf.
11. (kidney? adj5 (echograph* or echotomograph* or medical sonograph* or ultrasonic diagnos* or ultrasonic imag* or ultrasonic tomograph* or ultrasonographic imag* or ultrasonograph* or ultrasound?)).tw,kf.
12. RBUS.tw,kf.
13. or/9-12
14. 3 and 8 and 13
15. Animals/ not (Animals/ and Humans/)
16. 14 not 15
17. limit 16 to yr="2000 -Current"

EMBASE (Ovid)

1. exp urinary tract infection/
2. (urinary tract infection? or UTI or UTIs).tw,kw.
3. or/1-2
4. exp infant/
5. preschool child/
6. (babies or baby or infan* or neonat* or neo-nat* or newborn* or new-born* or paediatric* or peadiatric* or pediatric* or toddler?).tw,kw.
7. (pediatric* or paediatric* or infan* or child*).jn,jw. or (pediatric* or paediatric* or infan* or child*).in.
8. or/4-7
9. ultrasound/
10. (renal adj5 (echograph* or echotomograph* or medical sonograph* or ultrasonic diagnos* or ultrasonic imag* or ultrasonic tomograph* or ultrasonographic imag* or ultrasonograph* or ultrasound?)).tw,kw.
11. (kidney? adj5 (echograph* or echotomograph* or medical sonograph* or ultrasonic diagnos* or ultrasonic imag* or ultrasonic tomograph* or ultrasonographic imag* or ultrasonograph* or ultrasound?)).tw,kw.
12. RBUS.tw,kw.
13. or/9-12
14. 3 and 8 and 13
15. Animal experiment/ not (human experiment/ or human/)
16. (rat or rats or mouse or mice or swine or porcine or murine or sheep or lambs or pigs or piglets or rabbit or rabbits or cat or cats or dog or dogs or cattle or bovine or monkey or monkeys or trout or marmoset$1).ti. and animal experiment/
17. or/15-16

18. 14 not 17
19. limit 18 to yr="2000 -Current"

Cochrane Central Register of Controlled Trials (Ovid)

1. exp Urinary Tract Infections/
2. (urinary tract infection? or UTI or UTIs).tw,kw.
3. or/1-2
4. infant/ or exp infant, newborn/
5. child, preschool/
6. (babies or baby or infan* or neonat* or neo-nat* or newborn* or new-born* or paediatric* or peadiatric* or pediatric* or toddler?).tw,kw.
7. (pediatric* or paediatric* or infan* or child*).jn,jw. or (pediatric* or paediatric* or infan* or child*).in.
8. or/4-7
9. exp ultrasonography/
10. (renal adj5 (echograph* or echotomograph* or medical sonograph* or ultrasonic diagnos* or ultrasonic imag* or ultrasonic tomograph* or ultrasonographic imag* or ultrasonograph* or ultrasound?)).tw,kw.
11. (kidney? adj5 (echograph* or echotomograph* or medical sonograph* or ultrasonic diagnos* or ultrasonic imag* or ultrasonic tomograph* or ultrasonographic imag* or ultrasonograph* or ultrasound?)).tw,kw.
12. RBUS.tw,kw.
13. or/9-12
14. 3 and 8 and 13
15. Animals/ not (Animals/ and Humans/)
16. 14 not 15
17. limit 16 to yr="2000 -Current"

PsycINFO (Ovid)

1. (urinary tract infection? or UTI or UTIs).tw.
2. (babies or baby or infan* or neonat* or neo-nat* or newborn* or new-born* or paediatric* or peadiatric* or pediatric* or toddler?).mp.
3. ultrasound/
4. (renal adj5 (echograph* or echotomograph* or medical sonograph* or ultrasonic diagnos* or ultrasonic imag* or ultrasonic tomograph* or ultrasonographic imag* or ultrasonograph* or ultrasound?)).tw.
5. (kidney? adj5 (echograph* or echotomograph* or medical sonograph* or ultrasonic diagnos* or ultrasonic imag* or ultrasonic tomograph* or ultrasonographic imag* or ultrasonograph* or ultrasound?)).tw.
6. RBUS.tw.
7. or/3-6
8. 1 and 2 and 7
9. limit 8 to yr="2000 -Current"

CINAHL Plus (EBSCO)

1. (MH "Urinary Tract Infections+")
2. TI (("urinary tract infection#" or UTI or UTIs)) OR AB (("urinary tract infection#" or UTI or UTIs))
3. S1 OR S2
4. (MH "Infant+") OR (MH "Infant, Newborn+") OR (MH "Child, Preschool")
5. TI (babies or baby or infan* or neonat* or "neo-nat*" or newborn* or new-born* or paediatric* or peadiatric* or pediatric* or toddler#) OR AB (babies or baby or infan* or neonat* or "neo-nat*" or newborn* or new-born* or paediatric* or peadiatric* or pediatric* or toddler#)
6. S4 OR S5
7. (MH "Ultrasonography+")
8. TI (renal N5 (echograph* or echotomograph* or "medical sonograph*" or "ultrasonic diagnos*" or "ultrasonic imag*" or "ultrasonic tomograph*" or "ultrasonographic imag*" or ultrasonograph* or ultrasound#)) OR AB (renal N5 (echograph* or echotomograph* or "medical sonograph*" or

"ultrasonic diagnos*" or "ultrasonic imag*" or "ultrasonic tomograph*" or "ultrasonographic imag*" or ultrasonograph* or ultrasound#))

9. TI (kidney# N5 (echograph* or echotomograph* or "medical sonograph*" or "ultrasonic diagnos*" or "ultrasonic imag*" or "ultrasonic tomograph*" or "ultrasonographic imag*" or ultrasonograph* or ultrasound#)) OR AB (kidney# N5 (echograph* or echotomograph* or "medical sonograph*" or "ultrasonic diagnos*" or "ultrasonic imag*" or "ultrasonic tomograph*" or "ultrasonographic imag*" or ultrasonograph* or ultrasound#))
10. TI RBUS OR AB RBUS
11. S7 OR S8 OR S9 OR S10
12. S3 AND S6 AND S11
13. (MH "Animals")
14. (MH "Animals") AND (MH "Human")
15. S13 NOT S14
16. S12 NOT S15
17. Limiters - Published Date: 20000101-20211231

ClinicalTrials.gov (NIH)

- Ultrasonography | UTI | Child
- Urinary tract infection and Ultrasound
- Filters: Child (birth-17)

eTable 1. Definitions of clinically important abnormalities on kidney ultrasound reported in studies

Study	Clinically important abnormality definition described in study
Hoberman 2003*	Treatment was altered by the identification of abnormalities on renal ultrasound.
Hung 2016	Significant urologic abnormalities were defined as those that impacted on subsequent management with a change of therapy, investigations, or follow-up (e.g., surgical intervention, parental counseling, and need for follow-up of renal function) based on initial renal ultrasound findings. Parental counseling was defined as specified for children with hypoplastic kidney, solitary kidney, and multicystic dysplastic kidney, which needed long term follow-up of renal function and growth of the kidneys, and counseling for avoidance of potential nephrotoxic agents or factors. Significant urologic abnormalities included ureteropelvic junction obstruction, ureterovesical junction obstruction, hypoplastic kidney, duplex kidney, ureterocele, solitary kidney, and cystic kidney disease that were usually not visualized by voiding cystourethrography examination.
Jahnukainen 2006	Ultrasound findings that alone led to change in patient management.
Miron 2007*	Anomaly that affected management of patient.
Montini 2009*	Clinical management influenced by renal ultrasound results.
Wallace 2020	Abnormal renal ultrasounds were categorized into 3 categories based on the severity of findings. Abnormal findings were categorized into threshold A (mild abnormalities that could be incidental findings), B (moderate abnormalities that could lead to medical interventions, testing, or consultation), C (most severe, requiring close subspecialty follow-up and possible surgical intervention). The study provides further detail on which findings are classified as A, B, or C.
Wong 2010	Renal ultrasound detection of remediable abnormalities that require a change in management. Remediable urological abnormalities were arbitrarily defined as those abnormalities requiring surgical or medical intervention in addition to regular follow-up monitoring for urinary tract infection recurrence.
Zamir 2003	Impact on management was defined as a change of therapy, investigations, or follow up based on renal ultrasound results, that would not have been done otherwise.

Descriptions include text from primary studies

*Description of clinically important abnormality reported in the study results and not methods

eTable 2. Study Quality Assessment Tool and Response Explanation

Criteria	Response Explanation (Responses: Yes, No, Unclear, Not Applicable)
a. Was the sample representative of the target population?	Yes: Study focused on children with first febrile UTI, ages 0 to 24 months No: Study included children older than 24 months of age
b. Were study participants recruited in an appropriate and clear way?	Yes if: planned recruitment of consecutive patients, all during a specified time period No if: planned recruitment of non-consecutive patients, and/or recruitment of patients based on the performance of other imaging tests (e.g. only inclusion of children with ultrasound plus DMSA, VCUG)
c. Were the study subjects and the setting described in detail?	Yes if: described in sufficient detail, including whether children were hospitalized or not No if: no description
d. Were objective, standard criteria described for the diagnosis of UTI?	Yes if: provided criteria No: did not provide criteria
e. Were standard criteria described for abnormalities on US?	Yes if: defined US abnormalities in methods No if: did not define US abnormalities
f: Was the condition measured reliably?	Yes if: description of how US was conducted Unclear if: no or unclear reporting of US methods
g: Was there appropriate statistical analysis?	Yes if: statistical analysis reported with 95% CI for US abnormalities prevalence No if: statistical analysis not reported for prevalence of US abnormalities with 95% CI
h: Was the sample size adequate?	Yes if: planned sample size was reported and justified for outcome of prevalence of US abnormalities No: if planned sample size was not met Unclear if: sample size not justified
i: Was the data analysis conducted with sufficient coverage of the identified sample?	Yes if: few withdrawals and/or missing data on ultrasound abnormality outcome that are explained No if: too many withdrawals and/or missing data on ultrasound abnormality outcome or unexplained
j: Are all important confounding factors/subgroups/differences identified and accounted for?	Yes: authors identified and reported results for factors/subgroups (e.g. age, sex) that might be associated with ultrasound abnormalities No: no factors/subgroups identified or reported with respect to ultrasound abnormalities
k: Were subpopulations identified using objective criteria?	Yes: authors used objective criteria for defining subpopulations for US prevalence outcome No: authors did not use objective criteria for defining subpopulations for US prevalence Not applicable: if no subgroups were identified and accounted for

Quality assessment used adapted Joanna Briggs Institute Prevalence Critical Appraisal Tool

eTable 3. Quality Assessment of Studies

	Criteria										
Study	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
Arlen 2014	1	1	1	1	1	U	0	U	0	0	NA
Breinbjerg 2021	0	0	1	1	1	U	0	U	1	1	1
Cheng 2011	0	0	1	1	0	U	0	U	1	0	NA
Han 2016	0	0	1	1	0	U	0	U	1	0	NA
Harper 2016	1	1	0	1	1	U	0	U	1	0	NA
Hoberman 2003	1	1	1	1	1	U	0	U	1	0	NA
Hsu 2016	1	1	1	1	1	U	0	U	1	1	1
Huang 2008	0	1	1	1	0	1	0	U	1	0	NA
Hung 2016	1	1	1	1	1	1	0	U	1	0	NA
Ipek 2012	0	U	1	1	0	U	0	U	1	0	NA
Ismaili 2011	0	1	1	1	1	1	0	U	1	0	NA
Jahnukainen 2006	0	1	1	1	1	1	0	U	1	0	NA
Kawai 2019	1	0	1	1	1	U	0	U	1	0	NA
Kobayashi 2019	1	1	1	1	1	1	0	U	1	0	NA
Lee 2009	1	0	1	1	1	1	0	U	1	0	NA
Lertdumrongluk 2021	0	0	1	1	1	1	0	U	1	0	NA
Lytzen 2011	0	1	1	1	0	U	0	U	1	1	1
Miron 2007	1	1	0	0	1	U	0	U	1	0	NA
Montini 2009	1	1	1	1	1	1	0	U	1	0	NA
Pauchard 2017	1	1	1	1	1	1	0	U	1	0	NA
Pennesi 2012	0	1	1	1	1	U	0	U	1	0	NA
Pennesi 2021	0	0	1	1	1	U	0	U	1	1	1
Sasaki 2012	1	1	1	0	0	U	0	U	1	0	NA
Soccorso 2010	1	1	1	1	1	U	0	U	1	0	NA
Wallace 2020	1	1	1	1	1	U	0	1	1	1	1
Wongbencharat 2016	1	0	1	1	1	1	0	U	1	1	1
Wong 2010	1	1	1	1	_1	U	0	U	1	0	NA
Yilmaz 2016	0	1	0	1	1	U	0	U	1	1	1
Zamir 2004	0	1	1	1	1	1	0	1	1	0	NA

1 refers to Yes for criteria; 0 refers to No for criteria; U refers to Unclear; NA refers to Not Applicable

For criteria items a to k, refer to eTable 2 for criteria and explanation.

Quality assessment used adapted Joanna Briggs Institute Prevalence Critical Appraisal Tool

188 **eTable 4 Additional Study Characteristics**
189

Author and publication year	*E.coli* UTI, No. (%)	Renal US timing	Surgical Outcome Description in Methods	Surgical Outcome Follow-up Period	UTI definition as described in study methods
Arlen 2014	313 (89)	NR	NR	NA	Positive urine culture defined as a single organism of greater than 50,000 CFU obtained by catheterization.
Breinbjerg 2021	376 (89)	Within 6 weeks	Surgical correction of VUR or anatomic anomalies were noted.	NR	Any growth of a known uropathogen in urine on suprapubic bladder aspiration, growth of ≥ 10^4 CFU/ml in two consecutive clean catch midstream urine sample, or ≥ 10^3 CFU/ml if sampling by catheterization, were considered positive. Children with bag-collected urine samples were excluded.
Cheng 2011	NR	1st or 2nd day of hospitalization	NR	NA	UTI was diagnosed in the setting of a minimum of 10^5 CFU pathogen per ml in freshly voided mid stream urine or urine collected from a urinary bag, or more than 10^4 CFU bacteria per ml in catheterized urine, or any bacteria isolated from the urine of suprapubic aspirations.
Han 2016	NR	Within first 5 days of admission	NR	NA	Pyuria (≥5 WBCs per high-power field) and a positive urine culture collected from a clean-catch or catheterized specimen (defined as growth of a single organism to ≥100,000 CFU/ mL),
Harper 2016	293 (92)	Within 1 week of first episode	NR	NA	Positive urinalysis and urine culture results (>10^5 CFU/ml urine), with urine specimens collected through catheterization in girls and clean-catch in boys.
Hoberman 2003	298 (96)	Within 48 hrs of diagnosis	NR (Outcome reported in results and discussion)	6 months	The presence of pyuria (10 or more WBC/mm^3 in uncentrifuged urine) and bacteriuria (1 or more gram-negative rods per 10 oil-immersion fields in a Gram's stained smear of uncentrifuged urine). Inclusion in the final study group required a positive urine culture (at least 50,000 CFU per mL, representing a single pathogen) from a specimen obtained by catheter.
Hsu 2016	336 (86)	Within first 3 days of admission	NR	NR	Presence of pyuria [defined as ≥5 WBC per high power field] and/or abnormal dipstick urinalysis (a positive nitrite or leukocyte esterase test); a positive urine culture, defined as any growth of a single bacterium in urine from a suprapubic bladder aspiration, ≥5×10^4 CFU/mL collected from a transurethral catheterized specimen, or growth of a single microorganism ≥10^5 CFU/mL collected from the midstream clean-void urine specimen.
Huang 2008	NR	US was performed once UTI	NR	NA	UTI was defined as a positive urine monoculture, greater than 10^3 colony-forming units/mL in urine collected by suprapubic puncture or greater than 10^5 colony-forming units/mL in urine collected either in

		was suspected			sterile bags or by midstream clean-voided sample.
Hung 2016	263 (85)	Within first 2 days of admission	NR	NR	Pyuria (≥5 WBC per high-power field) and/or positive nitrite or leukocyte esterase tests, and presence of positive urine culture, defined as any growth of a single bacterium in urine from a suprapubic bladder aspiration, or growth of a single microorganism from 10^5 colony forming units/mL collected from the midstream clean-void urine specimen of toilet-trained young children, or 10^4 CFU/mL collected from a transurethral catheterized specimen.
Ipek 2012	53 (80)	Within 48rs after confirmation of UTI by urine culture findings	NR	NR	A positive urine culture with a single microorganism. Urine samples were obtained by suprapubic aspiration or transurethral catheterization in nontoilet-trained children and midstream clean-catch in toilet-trained children. Pyuria was defined as the presence of 5 leukocytes per a 40 objective high power field of urine. The diagnosis of UTI according to a positive urine culture was defined as any growth of a single bacterial pathogen from suprapubic aspiration, $\geq 10^5$ CFU/mL for midstream urine or $\geq 5x10^4$ colony-forming units/mL of urine for transurethral catheterization.
Ismaili 2011	189 (91)	Within 48hrs	NR	NR	Positive urinalysis defined as a trace or greater result for leukocyte esterase and/or nitrite on dipstick or as the presence of 35 leukocytes/L of un centrifuged urine. UTI was confirmed in those children having growth of 100,000 CFU per milliliter in urine culture. In urine samples obtained by suprapubic aspiration, any growth of enteric Gram-negative pathogens was considered significant. All urine samples from children younger than 24 months were obtained by suprapubic aspiration or a single bladder catheterization. Urine samples from older children were obtained by clean catch or bladder single catheterization.
Jahnukainen 2006	141 (91)	Within 3 days	Surgical intervention	NR	UTI was diagnosed by culturing urine specimens collected by suprapubic aspiration or two urinary bag specimens in children under 2 years of age and by midstream sample in older children. Single pathogen bacterial growth of 100,000 CFU/ml or more in two bag samples or in midstream specimen was considered significant. Any bacterial growth in urine obtained by subrapubic aspiration was considered significant.
Kawai 2019	54 (73)	≤ 1 month after fUTI onset	NR (Outcome reported in results.)	NR	Positive pyuria on urinalysis and a single organism $\geq 1 \times 10^5$/mL was isolated on urine culture from a catheterized urinary sample.
Kobayashi 2019	214 (93)	≤1 month after	NR	NA	Single uropathogen isolated from a specimen taken by urethral catheterization; and positive urinalysis (WBC≥5 per high-power field,

		diagnosis			positive leukocyte esterase test, positive nitrite test, or microscopy identification of bacteria); Lactobacillus spp., Corynebacterium spp., a-hemolytic streptococci and coagulase-negative staphylococci were considered contaminants.
Lee 2009	NR	Within 3 days after admission	NR (Outcome reported in results)	NR	Positive results on a urine culture was defined as any growth of bacteria in urine from a suprapubic bladder aspiration or 10,000 CFU per mL in a catheterized specimen.
Lertdumrongluk 2021	214 (82)	NR	NR	NA	Pyuria (≥5 WBCs per high power field of centrifuged urine), and presence of positive urine culture (defined as $\geq 10^5$ CFU/mL of a single bacterial growth collected midstream in toilet-trained children or $\geq 10^4$ CFU/mL collected by urethral catheterization in uncontrolled toilet-trained children).
Lytzen 2011	87 (90)	During initial hospitalization	NR (Outcome Reported in results)	Median 5.2 years (range 3.5 to 8.6 years)	Positive results for a urine culture were defined as any growth of bacteria in urine from a suprapubic bladder aspiration or more than 100,000 CFU per ml in 2 or eventually in 1 midstream urine sample.
Miron 2007	NR	Within 6 weeks of discharge	NR (Outcome reported in results)	NR	NR
Montini 2009[a]	NR	No later than 10 days after commencement of antibiotic therapy	NR (Outcome reported in results)	12 months	Urinalysis of an uncentrifuged specimen (2 concordant consecutive tests) yielding a white blood cell count of 25 cells per L (1 with a dipstick) and urine culture (with urine collected by using sterile bags that were changed every 20 –30 minutes; 2 concordant consecutive tests were required) yielding growth of only 1 microorganism at 100 000 CFU per mL.
Pauchard 2017	96 (72)	Within 6 days from admission	NR (Outcome reported in results)	24 months.	Positive urine culture was defined as a growth of a single microorganism $\geq 10^5$ CFU per mL with bladder catheterization, or any growth by suprapubic puncture.
Pennesi 2012	366 (90)	1 month after the UTI	NR	NA	Positive urinalysis (presence of leukocytes≥ 50/mm3 and bacteria $\geq 10/mm^3$ at optical microscopy), and urine culture (1 million CFU/mL) for the same bacterium in two different samples. Urine for urinalysis and urine culture was collected using clean catch or bladder catheterization.
Pennesi 2021	223 (84)	NR	NR	NA	Urine samples were collected by clean voided urine or by bladder catheterization if clean catch was not possible. In febrile children in poor general clinical condition, urine samples were collected by transurethral bladder catheterization or suprapubic aspiration.

Sasaki 2012	NR	NR	NR	NA	NR
Soccorso 2010	286 (67)	During admission	NR (Outcome reported in results)	NR	Culture-proven pure growth of an organism (>10^5 colony-forming units/high-power field) from an appropriately collected urine sample. The sample was collected as a clean-catch midstream urine sample. Where this was not possible, a suprapubic aspirate was obtained.
Wallace 2020	180 (85)	During admission	Surgical interventions	6 weeks	Urine specimens by either catheterization or suprapubic aspiration. For children 2 to 24 months of age, UTI was defined as 50,000 CFU of bacteria plus urinalysis with pyuria. Pyuria was defined as either a positive leukocyte esterase result and/or 5 WBC per high-power field. For infants, 2 months of age, infants could either have 50,000 CFUs of bacteria on urine culture regardless of the urinalysis result or 10,000 CFUs of bacteria with pyuria on urinalysis.
Wongbencharat 2016	NR	Within 2 weeks after UTI was diagnosed	NR	NA	Both pyuria (>5 white blood cells/HPF) and positive urine culture (>10^3 CFU/mL of a single uropathogenic organism on bladder catheterization)
Wong 2010	689 (84)	As soon as possible	NR (Outcome reported in results)		Positive urinalysis (including dipstick for leucocyte esterase and nitrite and/or microscopy for leucocytes and bacteria) and significant urine culture of a properly collected urine sample.
Yilmaz 2016	268 (89)	Within 10 days of commencement of antibiotic therapy	NR	NA	A positive urine culture of a single microorganism, and a colony count higher than 10^5 CFU/ml. Urinary samples were obtained with the mid-stream clean-catch method in toilet-trained children and with a catheter in non-toilet-trained patients. A cut-off level of 50,000 CFU/ml was used in the latter group.
Zamir 2004	229 (85)	During hospitalization	NR	NA	Positive urine culture, growth of >100 bacteria/ml in a midstream sample or any growth in suprapubic bladder aspiration or in/out bladder catheterization.

CFU refers to colony forming units [a]Extracted data from related clinical trial.

NR, not reporter; NA, not applicable.

194
195 **eTable 5.** Kidney Ultrasound Reporting in Studies
196

Study	Definition of Abnormal Renal Ultrasound	Grading of Hydronephrosis	Radiologist review of US	Details on US review process
Arlen 2014	Any degree of calyceal or ureteral dilatation, parenchymal echogenicity or scarring, renal atrophy, alterations in corticomedullary-differentiation or urothelial thickening.	SFU	NR	NR
Breinbjerg 2021	The findings of kidney US were noted. Hydronephrosis was defined as pelvis anteroposterior diameter > 10 mm or calyxes anteroposterior diameter > 5 mm; hydroureter was defined as a distal ureter > 3 mm.	Hydronephrosis was defined as pelvis anteroposterior diameter > 10 mm or calyxes anteroposterior diameter > 5 mm; hydroureter was defined as a distal ureter > 3 mm.	NR	NR
Cheng 2011	NR	Mild hydronephrosis (pelvic dilatation 10 mm or less)	NR	NR
Han 2016	NR	NR	NR	NR
Harper 2016	Post-UTI sonographic findings showing any degree of hydronephrosis, dilatation of calyces or ureter, signs of renal dysplasia, or abnormal renal outline were considered to indicate an abnormality.	NR	NR	NR
Hoberman 2003	Anatomic abnormalities. Dilated pelvis, Pelvocaliectasis, Hydronephrosis, Dilated ureter, Double collecting system, Extrarenal pelvis, Calculus.	NR	NR	NR
Hsu 2016	All abnormal US findings were recorded, including the anteroposterior diameter of the renal pelvis ≥5mm and/or any grade of dilatation of the calyces or ureters irrespective of anteroposterior diameter; pelvic or ureteral wall thickening; absence of cortico-medullary differentiation; renal hypoplasia; duplicated renal collecting system; and abnormal kidney size.	NR	NR	NR
Huang 2008	NR	NR	NR	All ultrasound scans were reviewed by at least three to

				ensure uniform findings.
Hung 2016	All abnormal US findings were recorded, including 7-mm anteroposterior diameter of the renal pelvis, and/or any grade of dilatation of the calyces or ureters irrespective of anteroposterior diameter; pelvic or ureteral wall thickening; absence of cortico-medullary differentiation; irregular renal outline and signs of renal hypoplasia (i.e., small kidney and thinned or hyperechoic cortex); duplicated renal collecting system, abnormal kidney size, renal cysts, dysplastic kidney, stenosis of the ureteropelvic junction, or ureterovesical junction and ureterocele. Renal hypoplasia was defined as a longitudinal length of kidney less than 2 standard deviations for age, and nephromegaly as a renal length greater than 2 standard deviations for age. Examination of the bladder was also performed to detect dilatation of the distal ureters, bladder wall hypertrophy, and presence of ureterocele.	NR	NR	At least two investigators reviewed all US reports to ensure uniform findings.
Ipek 2012	NR	NR	NR	NR
Ismaili 2011	The criteria for abnormal US included pelvic anteroposterior diameter 7-mm, calyceal or ureteral dilatation, pelvic or ureteral wall thickening, absence of the corticomedullary differentiation, and signs of renal dysplasia (small kidney, thinned or hyperechogenic cortex, and cortical cysts).	NR	Same trained pediatric radiologists performed US.	NR
Jahnukainen 2006	An abnormal US finding was considered significant if treatment (surgical intervention, prophylactic antibiotics, need for follow-up, or counsel-ling) was influenced based on the result of US. Abnormalities, such as ureteropelvic junction obstruction, ureterovesical junction obstruction, urethral valve, ureterocele, solitary kidney, cystic kidney diseases, renal dysplasia, or hypoplasia were considered as potential conditions that would change the treatment and that are usually not visualised by VCUG.	Posteroanterior diameter >10 mm	Experienced pediatric radiologists performed and analysed US.	The imaging study reports were reviewed by two Pediatricians. A pediatric radiologist was consulted as necessary.
Kawai 2019	Renal US findings were recorded on a standard sheet documenting renal length, ureteral dilatation, kidney/bladder tumor lesions, calculus, bladder volume, degree of bladder retention, bladder wall thickness. Abnormal findings indicating need for VCUG were: unilateral renal agenesis, double renal pelvis and ureters,	SFU	Physician in outpatient department (pediatrics or pediatric urology) or a	The pediatricians and technicians were provided with standardized

	Left/Right renal length difference >10mm, renal length <45mm, hydronephrosis> grade 2 based on SFU, ureteral dilation, bladder volume >150% expected bladder volume.		lab technician performed US.	data recording sheets to avoid discrepancies in inter-examiner diagnosis
Kobayashi 2019	Renal ultra-sonography was interpreted as follows: renal length was considered abnormal if it was≥2 SD of the mean in comparison with the age-based reference range for Japanese children. Dilation of the renal pelvis was graded according to the definition of the Society of Fetal Urology (SFU). We defined abnormal findings as SFU grade≥2, which corresponds to moderate–severe dilation of the renal pelvis and calices; anteroposterior diameter of ureter≥7 mm, which corresponds to moderate–severe dilation of ureter; and renal pelvic wall thickness≥0.8 mm.	SFU	Pediatric radiologists performed and evaluated US.	NR
Lee 2009	All abnormal ultrasound scanning findings were recorded, including dilatation of the pelvis, calyx, or ureter (any dilatation of ureter seen on ultrasound scanning), cyclic dilatation of pelvicaliceal system, wall thickening in the pelvis (a circumferential hypo-echoic rim delineated on each side by thin hyperechoic lines, the rim being thicker than 0.8 mm), ureter, or bladder (3mm in a full or 5 mm in an empty bladder), swelling or thinning of renal parenchyma, diffuse or focal increased renal echogenicity with absence of corticomedullary differentiation, renal abscess, irregular renal outline, and signs of renal hypo-dysplasia (small kidney, thinned or hyperechoic cortex, and cortical cysts) or a duplicated renal collecting system.	SFU	Performed by a pediatric nephrologist.	NR
Lertdumrongluk 2021	Hydronephrosis, double collecting system, increased parenchymal echogenicity, and ectopic kidney.	NR	Qualified radiologists performed US.	NR
Lytzen 2011	NR	NR	NR	NR
Miron 2007	Grading of ultrasonographic renal findings was divided into normal, mild, moderate and severe (hydronephrosis) pelvic dilatation and according to other specified findings.	NR	Expert in pediatric radiology read US.	Radiologists was unaware of the purpose of the study and blinded to the results of the antenatal RUS.

Montini 2009	Any alteration, however minor. The ultrasound results were considered positive even when the morphologic changes were minimal (for example, mild dilation of the renal pelvis, mild increase in renal volume, any discernable increase in the thickness of the pelvic mucosa, or debris present in the bladder)	NR	Qualified radiologists performed US	The radiologists were blinded to clinical, laboratory, and other data regarding the patients.
Pauchard 2017	Renal pelvic anteroposterior diameter≥5mm, and/or any grade of dilatation of calyces or ureters, and/or pelvic or ureteral wall thickening.	NR	Trained pediatric radiologists performed US.	
Pennesi 2012	Either abnormal renal length—maximum longitudinal diameter <5th percentile—ureteral dilatation, pelvic dilatation or abnormal cortico-medullary differentiation		Skilled radiologists performed US	NR
Pennesi 2021	Hydronephrosis, ureteric dilatation, hypoplasia, duplicated system, bladder abnormalities	SINEPE guidelines, which references the SFU.	US performed in radiology department.	NR
Sasaki 2012	NR	NR	NR	NR
Soccorso 2010	The US examination was considered normal in the case of bilateral normal kidneys, with no evidence of hydroureteronephrosis or bladder abnormality.	NR	Pediatric radiologists reported US.	Six paediatric radiologists reported individual imaging studies and were blinded to the reports of other studies for the same infant.
Wallace 2020	Threshold A findings were mild abnormalities that could be incidental findings or related to the UTI itself. Threshold B findings were moderate abnormalities that could lead to medical interventions, further testing or need for subspecialty involvement. Threshold C findings were considered to be severe abnormalities for which close subspecialty follow-up and possible future surgical interventions might be needed.	SFU	Pediatric radiologists read each US	As part of clinical care, pediatric radiology staff read each US examination.

Wongbencharat 2016	All abnormal RBUS findings were recorded including swelling or thinning of renal parenchyma, diffuse or focal increased renal echogenicity with absence of corticomedullary differentiation, signs of renal hypodysplasia, duplicated collecting system and dilatation of the calyx, pelvis, ureter or urethra.	NR	Experienced radiologists performed US.	NR
Wong 2010	For US, the bilateral renal length, pelvicaliceal or ureteric dilatation, pre-and post-void bladder volumes were assessed. The magnitude of renal pelvic dilatation was defined by the maximal anteroposterior diameter (APD) of the pelvis measured in the transverse plane (considered as abnormal if >5 mm).	Unclear	Radiologists performed and reported US.	
Yilman 2016	Hydronephrosis, renal hypoplasia/ dysplasia, renal cysts, a duplicated collecting system, and urolithiasis were defined as abnormal US findings.	NR	NR	NR
Zamir 2004	It consisted of examination of the kidneys in order to show the kidney size, renal outlet obstruction (such as pelvic-uretro junction stenosis), collecting system dilatation, parenchymal structure, and parenchymal lesions such as an abscess. Also examination of the bladder was done in order to identify dilatation of the distal ureters, hypertrophy of the bladder wall, and presence of ureteroceles.	Renal pelvis dilatation was defined as suggestive of VUR and graded as mild, moderate, or severe (hydronephrosis).	Experienced radiologists read US.	NR

Descriptions are include text from primary studies; SFU = Society of Fetal Urology classification system.

NR, not reported.

eResults. Sensitivity Analyses for Outcome of Urinary Tract Abnormalities

For the analysis of prevalence of any ultrasound abnormality, Lee et al.[46] and Han et al.[53] were identified as an outliers, however, when these studies were individually removed in the sensitivity analyses, the overall prevalence was not substantially impacted (21.0%, 95% CI 16.1%-26.5% and 20.7%, 95% CI, 16.1-25.6, respectively).

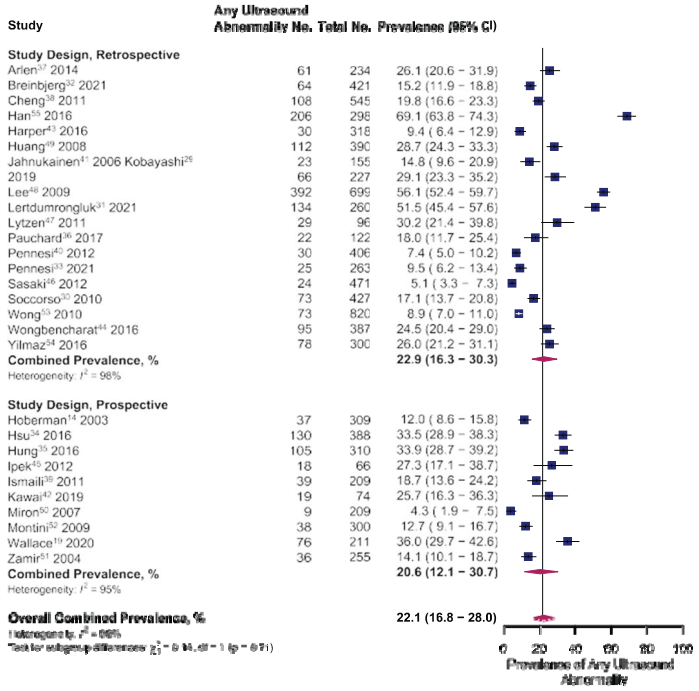
eTable 6. Prevalence of specific abnormalities detected on kidney ultrasound after first episode febrile urinary tract infection

Abnormality	Studies Reporting, No.	No. with Abnormality	Total No.	Pooled Prevalence (95% CI)	I^2
Hydronephrosis	21	843	6848	9.2 (5.1-14.3)	98%
Pelviectasis/Dilated Pelvis	10	259	3920	6.0 (2.3-11.2)	96%
Dilated Ureter	10	106	3401	2.9 (1.3-5.2)	89%
Other Bladder abnormalities	5	44	1962	2.0 (1.2-3.0)	48%
Double collecting system	17	88	5636	1.4 (0.7- 2.3)	81%
Ureterocele	5	15	1742	0.8 (0.4–1.3)	0%
Solitary Kidney	3	6	852	0.7 (0.2-1.4)	0%
Multicystic/Polycystic Kidney	6	7	1455	0.4 (0.1-0.8)	0%
Urinary Tract Obstruction	12	23	3761	0.4 (0.1-0.8)	59%
Dilated Posterior Urethra/Posterior Urethral Valve	3	3	1017	0.2 (0-0.9)	47%
Extrarenal Pelvis	2	1	1129	0.1 (0-0.7)	58%
Calculus	4	4	1894	0.1 (0-0.3)	7%
Abnormal Corticomedullary Differentiation	2	0	933	0.0 (0-0.2)	0%

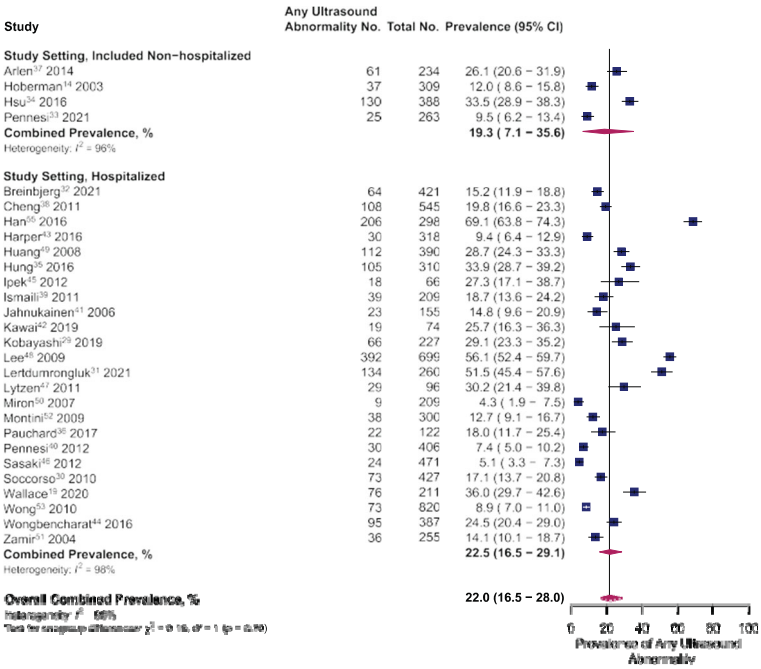
Pooled prevalence from random effects meta-analysis

eFigure 1. Pooled Prevalence of Urinary Tract Abnormalities Detected on Kidney Ultrasound After First Febrile Urinary Tract Infection in Children, Subgroup Analyses

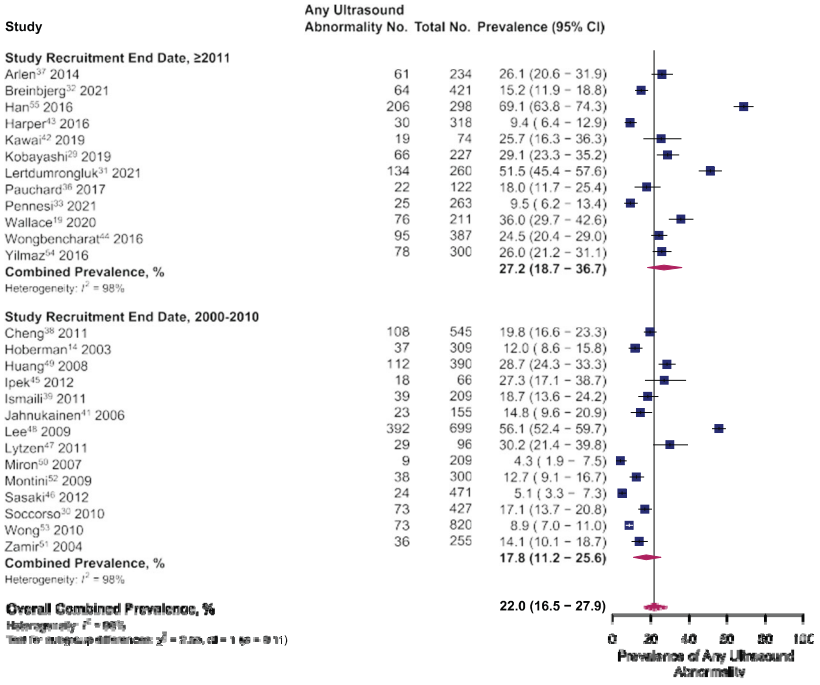
a. Retrospective vs. Prospective Study Design



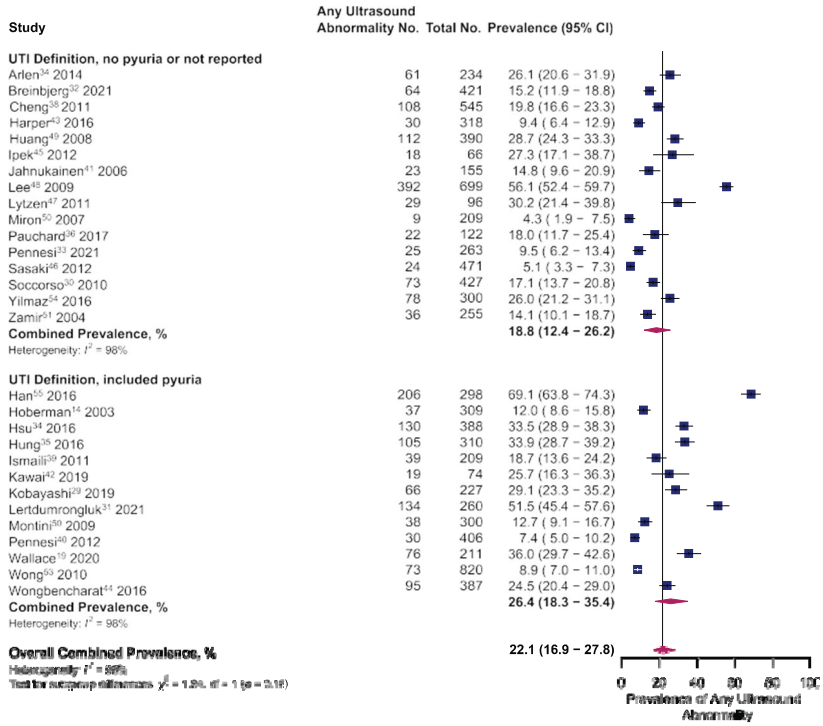
b. Hospitalized vs. Inclusion of Non-hospitalized Study Setting



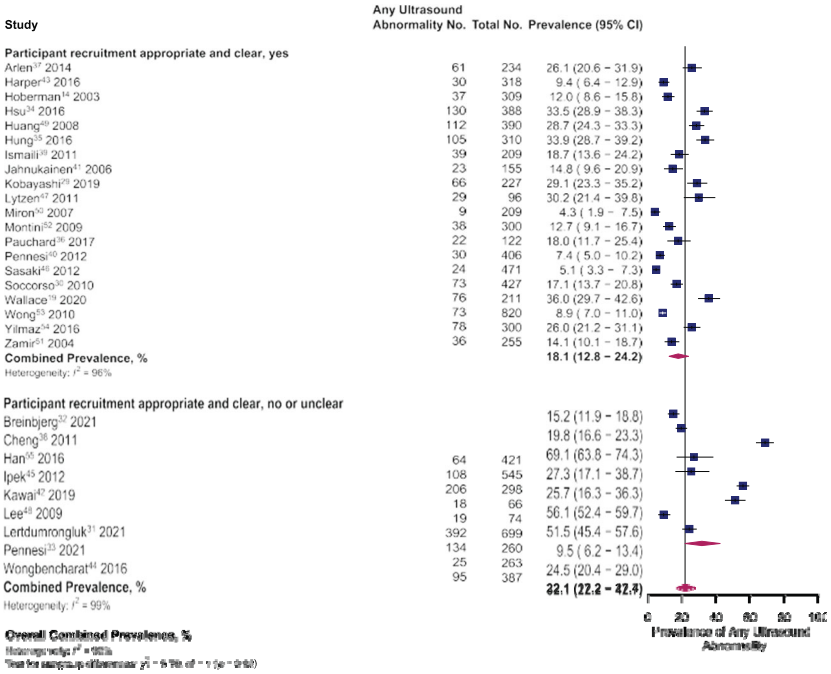
c. Recruitment End Date 2000-2010 vs. after 2010



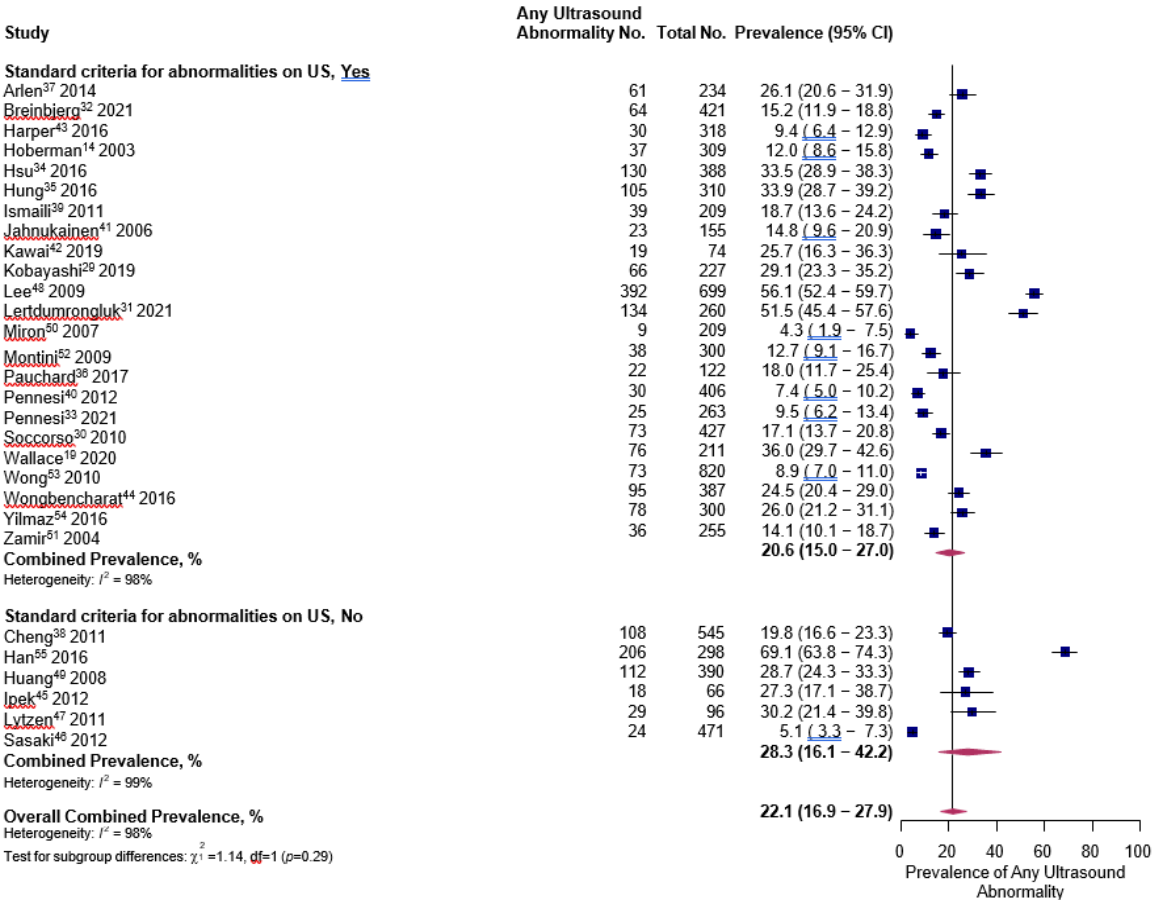
d. Pyuria included in Urinary Tract Infection Diagnosis Criteria



e. Study Quality Item: Participant Recruitment Appropriate and Clear

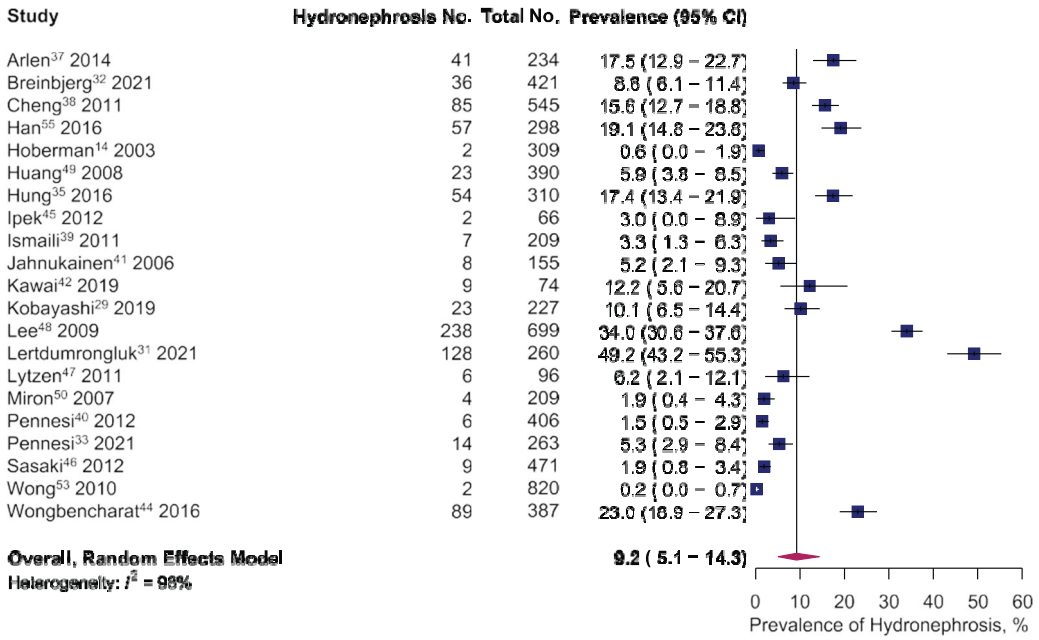


f. Study Quality Item: Standard Criteria Described for Abnormalities on Renal Ultrasound

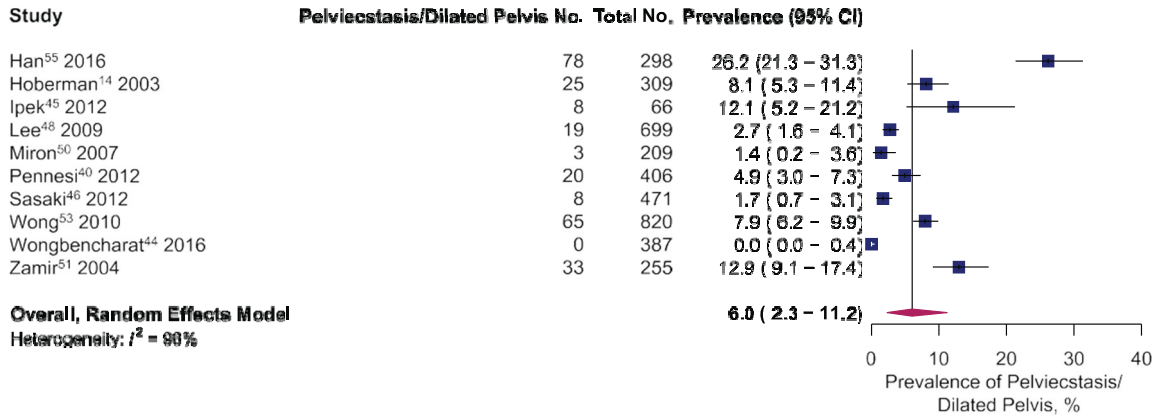


eFigure 3. Pooled Prevalence of Specific Abnormalities Detected on Kidney Ultrasound After First Febrile Urinary Tract Infection in Children

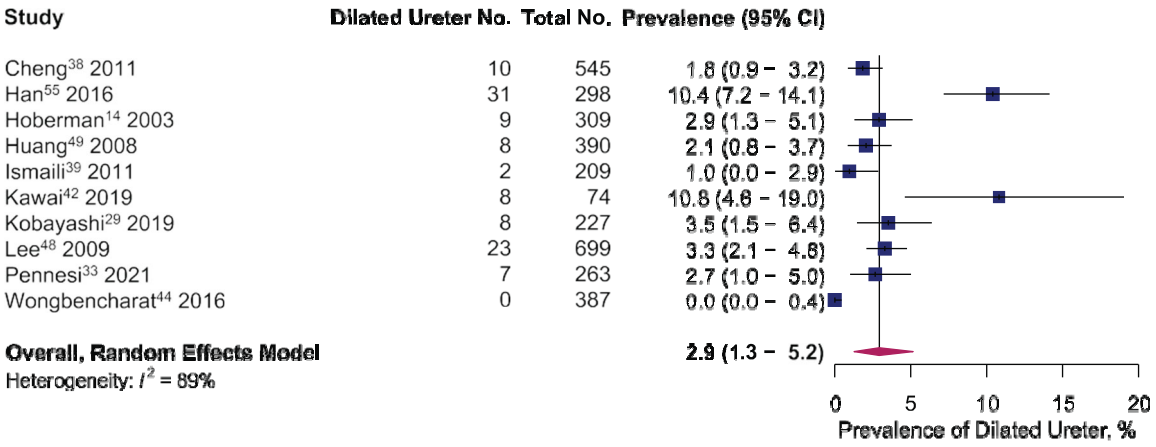
a. Hydronephrosis



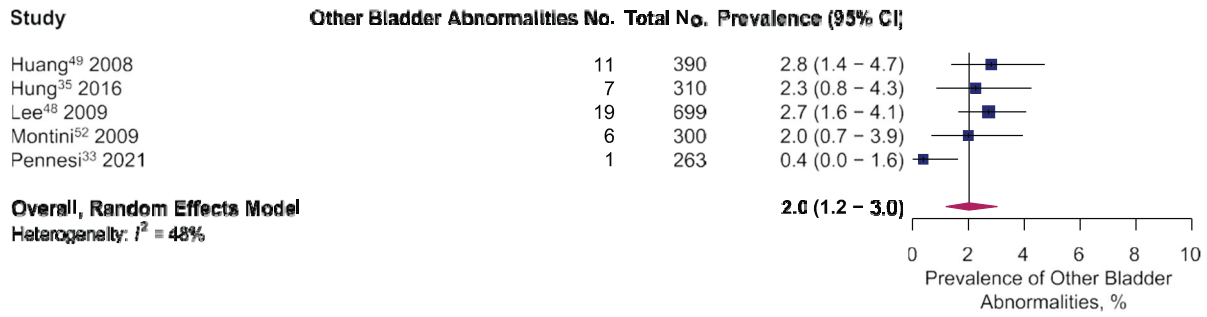
b. Pelviectasis/Dilated Pelvis



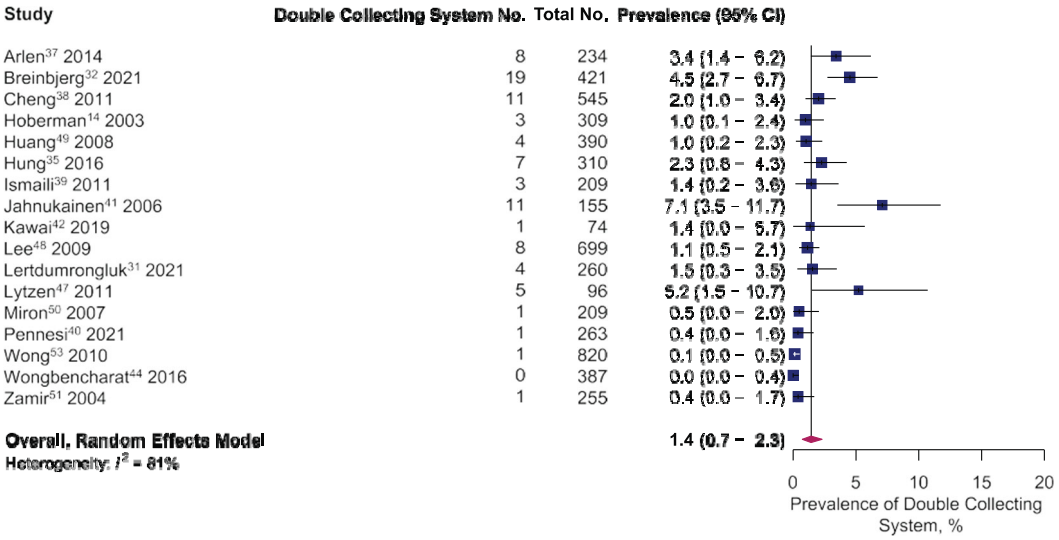
c. Dilated Ureter



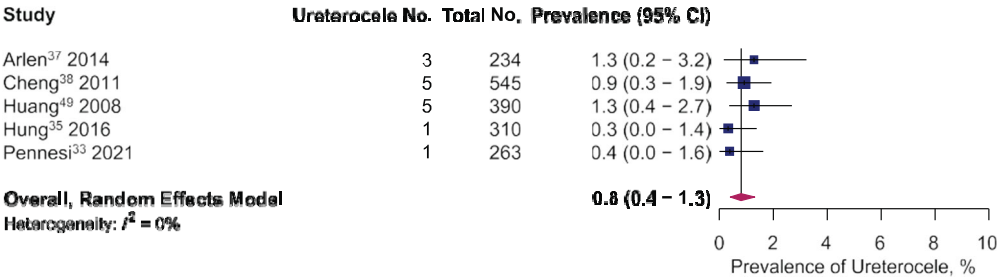
d. Other Bladder Abnormalities



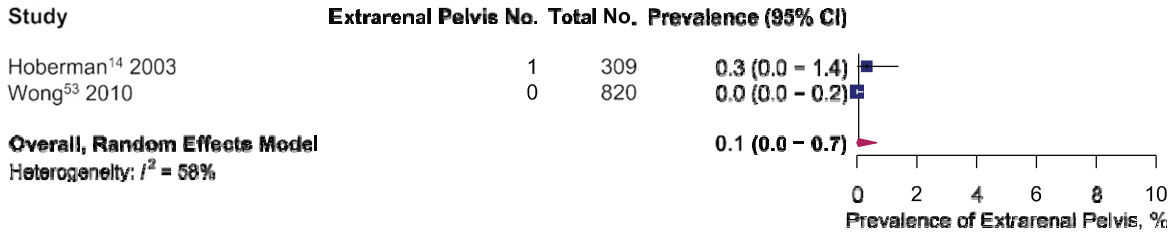
e. Double Collecting System



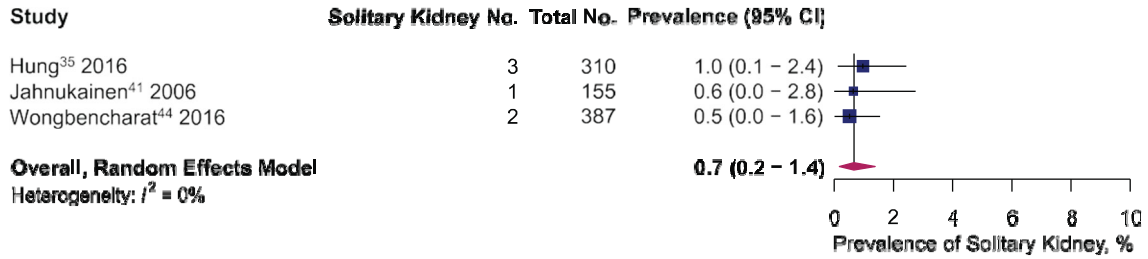
f. Ureterocele



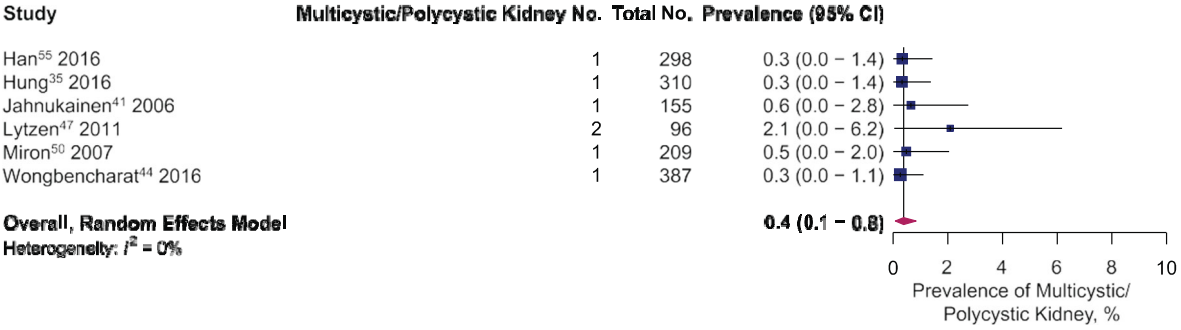
g. Extrarenal Pelvis



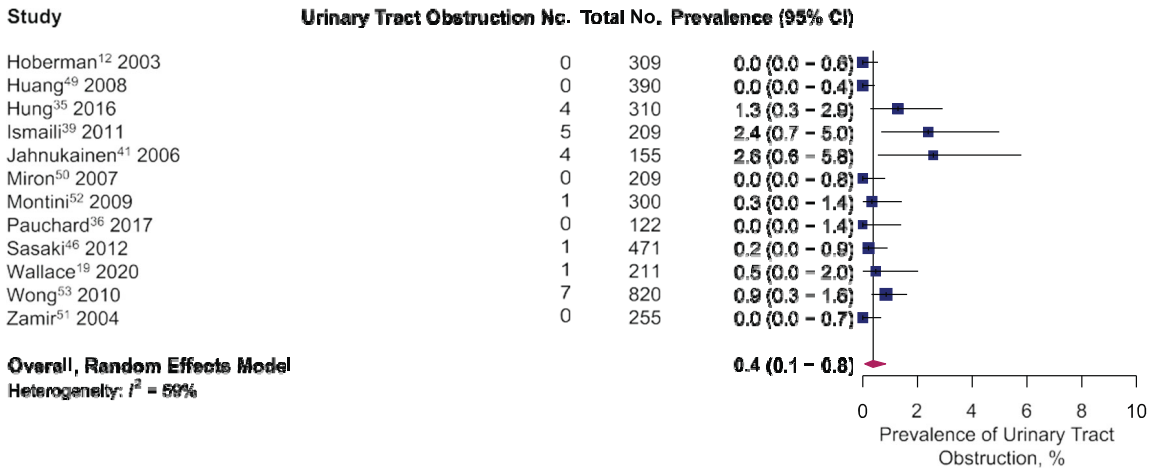
h. Solitary Kidney



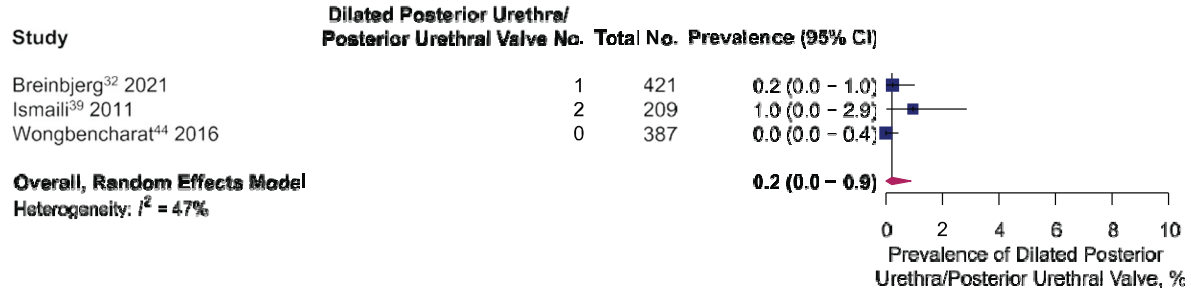
i. Multicystic/Polycystic Kidney



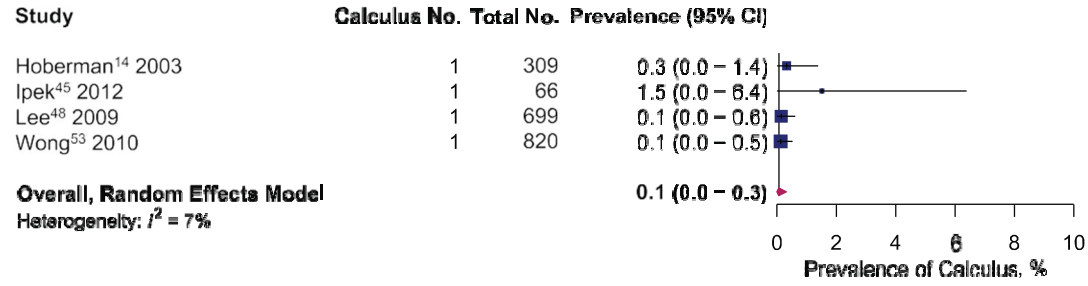
j. Urinary Tract Obstruction



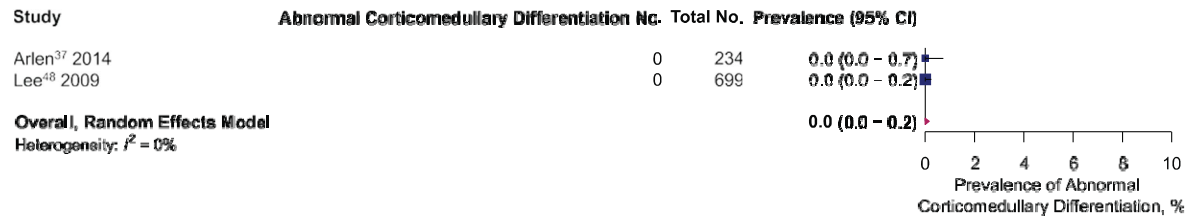
k. Dilated Posterior Urethra/Posterior Urethral Valve



l. Calculus



m. Abnormal Corticomedullary Differentiation



eFigure 4. Pooled Prevalence of Surgical Intervention of the Urinary Tract