Evidence-based Clinical Management of Pediatric Vesicoureteral Reflux and Prognostic-Factor–Guided Treatment Selection

1. Executive Summary

Contemporary pediatric vesicoureteral reflux (VUR) management is best understood as **risk-stratified prevention of febrile urinary tract infection (fUTI) and infection-associated renal injury**, rather than a reflexive pursuit of radiographic "cure" in every child. Multiple cohorts and guideline summaries emphasize that **spontaneous resolution is common**, particularly for low-grade reflux and in younger children, with estimates such as ~80% spontaneous resolution for grades I–II (and ~50% for grade III and ~20% for grades IV–V) when detected at birth, and resolution that depends on grade, sex, and age at diagnosis in older children.[1] Additional observational data show markedly lower resolution in higher grades (e.g., 85.5% for grade I–II vs 6.7% for grade IV–V in one series).[2]

Four management pathways dominate practice and the evidence base reflected in the provided sources: **(1) conservative observation**, **(2) continuous antibiotic prophylaxis (CAP)**, **(3) endoscopic injection**, and **(4) ureteral reimplantation (open or minimally invasive)**.[1, 3, 4] Across guideline statements and trials, CAP is increasingly positioned as **selective** rather than universal—explicitly noted in European guidance ("CAP may not be required in every VUR patient")—and is targeted toward higher-risk phenotypes such as symptomatic infants, higher-grade reflux, bladder-bowel dysfunction (BBD), renal cortical abnormalities, or a history of fUTI recurrence.[5, 6]

When escalation is needed, evidence and guidelines converge on two key inflection points: **breakthrough febrile UTIs despite CAP** and **evidence of renal injury (cortical defects/scarring or scintigraphic deterioration)**. The AUA guidance summarized in the sources recommends that a child who develops a febrile breakthrough UTI while receiving CAP be considered for **curative-intent intervention** (open ureteral reimplantation or endoscopic injection of bulking agents).[1] Multiple studies also link fUTI recurrence to renal deterioration on scintigraphy and to renal cortical defects on DMSA in association with higher VUR grades and recurrent fUTIs, reinforcing why infection prevention is central to management decisions.[7, 8]

2. Pathophysiology and Rationale for Treatment

The clinical importance of VUR in the sources provided centers on its association with **recurrent febrile UTIs** and **renal parenchymal injury identified by scintigraphy**. In a randomized infant trial (77 infants <8 months with grade 4–5 reflux), deterioration on scintigraphy at 1 year occurred in eight children, and explanatory analyses found that **6/8 had one or more febrile UTIs between scans**, supporting a relationship between infection episodes and renal deterioration.[7]

Similarly, a large observational DMSA-based study of 565 children referred for febrile UTI and/or VUR reported **focal cortical defects on non-acute DMSA in 15.5%** (84/541, after excluding presumed congenital reflux nephropathy cases) and found strong associations with higher VUR grades and with recurrent febrile UTIs (≥2 fUTIs).[8] In multivariable modeling from that cohort, grades IV–V had markedly elevated odds of focal defects compared with no VUR (grade IV OR 28.2; grade V OR 84.9), and ≥2 febrile UTIs increased risk (OR 3.9).[8] Together, these data support a management rationale that prioritizes **reducing febrile UTI recurrence** and intervening when there is evidence of renal injury risk (high grade, recurrent febrile UTI, or DMSA abnormalities).[7, 8]

3. Diagnostic Workup That Drives Management

Management decisions in the sources are driven by three domains: **(1) reflux severity (grade and laterality), (2) renal parenchymal status on nuclear imaging, and (3) lower urinary tract function including BBD**.

VCUG-based grading is fundamental to risk stratification in these sources because both treatment response and renal-risk associations depend strongly on grade. For example, endoscopic trials and meta-analyses define treatment success or follow-up status using VCUG outcomes (e.g., absence of VUR on post-procedure VCUG at 3 months, and recurrent dilating reflux on later VCUG).[1, 9] The infant high-grade reflux RCT also used follow-up grading to define "downgrading to ≤II" as a principal endpoint and demonstrated strong dependence of outcomes on baseline grade and unilaterality (e.g., 100% in unilateral grade 4 vs 31% in bilateral grade 5 after endoscopic therapy).[7]

Renal scintigraphy is used in these sources to identify renal cortical abnormalities and track deterioration. The large DMSA observational study used non-acute DMSA scintigraphy to define focal cortical defects (presumed acquired renal damage), with scans reviewed by two blinded pediatric radiologists and consensus adjudication, supporting the methodological robustness of renal lesion ascertainment.[8] In the infant RCT, scintigraphic deterioration at one year served as a clinically meaningful renal outcome that correlated with febrile UTIs during follow-up.[7]

BBD evaluation is emphasized as a prerequisite to definitive reflux-focused treatment in European guidance: "all children presenting with UTIs should be carefully evaluated for the presence of BBD and managed accordingly, before any treatment of VUR."[5] BBD is also common: among toilet-trained children in a prospective analysis, BBD was present at baseline in 54% and was accompanied by daytime wetting/withholding maneuvers/constipation in 94% of those affected.[10] In meta-analytic data, pooled BBD prevalence in primary VUR was 49% (30 studies; 5,060 patients), and BBD prevalence was higher in females than males (53% vs 44%).[11]

4. The Four Management Options

4a. Conservative observation

Observation is supported by the high frequency of spontaneous resolution in many children and by the strong dependence of resolution on baseline grade and patient factors. At birth, approximate spontaneous resolution probabilities are reported as ~80% for low-grade (I–II), ~50% for grade III, and ~20% for high-grade (IV–V).[1] Resolution in older children also varies with grade, gender, and age at diagnosis, reinforcing the need for individualized follow-up rather than a uniform intervention threshold.[1]

Quantitative natural-history estimates in the provided sources also include resolution rates such as **13% per year for grades I–III during the first 5 years** (and 3.5% yearly thereafter), and **5% per year for grade IV** in one synthesis of observational data, emphasizing how strongly persistence is tied to grade.[12] A longer follow-up cohort similarly found resolution by maximum grade of 85.5% for grade I–II, 45.8% for grade III, and 6.7% for grade IV–V, with overall resolution higher in boys than girls (39.5% vs 28.0%).[2]

Guideline statements in the provided sources operationalize these data by endorsing surveillance pathways for low-risk phenotypes. EAU/ESPU guidance recommends offering "close surveillance without antibiotic prophylaxis" to children with **lower grades of reflux and without symptoms**.[5] Similarly, a guideline summary states that for children who have completed toilet training, observation is recommended for grade I–II VUR **without cortical abnormalities**.[6]

4b. Continuous antibiotic prophylaxis

The strongest randomized evidence included in the provided sources comes from the **Randomized Intervention for Children with Vesicoureteral Reflux (RIVUR) trial**, in which TMP-SMX prophylaxis in children aged 2–71 months reduced UTI recurrence by about half over two years (HR 0.50; 95% CI 0.34–0.74) and reduced absolute recurrence risk by 12%.[3, 4] Subgroup analyses reported a larger relative benefit in children with BBD (HR 0.21; 95% CI 0.08–0.58) and in those with febrile or symptomatic index infection (HR 0.41; 95% CI 0.26–0.64).[3]

However, the sources consistently emphasize that CAP does not reliably translate into reduced renal scarring outcomes over the follow-up periods studied. One RIVUR synthesis reports **no between-group difference in new renal scarring** (6% vs 7% of children; 4% vs 4% of renal units).[3] Evidence summarized from older controlled data also reports that new renal scar incidence did not differ after antibiotic treatment (6–12%) compared with open surgical repair (5–14%).[1]

Antimicrobial resistance is a recurring trade-off in prophylaxis strategies. RIVUR-related reporting in the provided sources notes increased resistance among treatment-group E. coli isolates in first febrile or symptomatic recurrences (63% vs 19%, p<0.001).[3] Another RIVUR-derived summary similarly reports higher antibiotic-resistant bacteria among recurrent fUTIs in CAP-treated children than untreated children (68.4% vs 24.6%).[6]

Guideline positioning in the provided sources reflects this balance between UTI prevention benefit and stewardship concerns. EAU/ESPU guidance explicitly states CAP "may not be required in every VUR patient," recommends CAP for all symptomatic infants diagnosed in the first year of life regardless of grade or focal uptake defects, and recommends that children presenting at age 1–5 years be managed initially with medical treatment.[5] For infants with grade III–V VUR and no previous UTIs in the PREDICT RCT, CAP had a modest benefit preventing a first UTI with **number needed to treat of seven over 2 years**, without differences in kidney scarring, kidney function, or hospitalization, while increasing non–E. coli organisms and antibiotic resistance.[5]

4c. Endoscopic injection

Endoscopic injection therapy (often described using Dx/HA or "Deflux") is presented across the sources as a less invasive, curative-intent alternative to ureteral reimplantation, typically offered for scenarios such as breakthrough UTI, progressive renal scarring, poor compliance, lack of resolution over time, or parental preference.[13]

Effectiveness depends on definitions and follow-up duration, but multiple quantitative summaries are available. One review-level summary reports endoscopic injection success rates of **70–90%** (lower than surgical options but effective for lower grades).[4] A systematic meta-analysis summary reports single-injection success of **83.0% (95% CI 69.1–91.4)**.[1] European guideline synthesis provides grade-stratified estimates after one injection (78.5% grade I–II, 72% grade III, 63% grade IV, 51% grade V) and reports an aggregate success rate of **85%** across one or more injections.[5]

Durability is an important limitation to counsel families on. Recurrence of reflux after injection is reported in the range of **17% to 47.6% of ureters** (median 26%).[1] Post-injection UTI rates also vary, with febrile UTI incidence reported from **0–21%** across series and recurrent dilating reflux of 20% at 2-year VCUG in one study, alongside 21% with one or more recurrent febrile UTI after injection in the same report.[1]

Predictors of endoscopic success in the sources include **lower pre-operative reflux grade** and **absence of functional/anatomic bladder abnormalities** (including voiding dysfunction/neuropathic bladder, duplicated systems, and ureterocele).[1] In addition, guidance-level summaries explicitly state that BBD does not affect open surgery cure rates but does affect endoscopic procedures, and that endoscopic resolution is significantly reduced in the presence of BBD.[1, 6]

Safety signals in endoscopic cohorts vary by agent and study, but obstruction is a known potential complication in some series. In a randomized comparison of polyacrylamide hydrogel and Dx/HA, 2 patients in the Dx/HA arm had symptomatic ureteral obstruction shortly after surgery, with one requiring a temporary ureteral stent, illustrating that although uncommon, obstruction can occur and may require intervention.[9]

4d. Surgical reimplantation

Open ureteral reimplantation remains the highest-certainty curative option in the provided sources, with an estimated success rate of **98.1% (95% CI 95.1–99.1)** in one synthesis and guideline-level reporting of **95–99%** success for primary VUR irrespective of reflux severity.[1, 6] A review-level statement also describes open surgery as "highly effective regardless of the method applied" and as recommended for patients with urinary tract malformations or functional abnormalities such as BBD and duplicate ureters, reflecting a tendency to favor open repair in anatomically or functionally complex scenarios.[4]

When considering clinical outcomes beyond radiographic cure, longer-term comparative data summarized in the sources show febrile UTI recurrence at 10 years of **14%** in the open surgery group versus **25%** in the antibiotic prophylaxis group in the International Reflux Study in Children, while **new renal scarring rates did not differ** between antibiotic treatment (6–12%) and open surgical repair (5–14%) in evidence summarized in the same guideline review.[1]

Minimally invasive approaches are presented as having high success rates as well. Laparoscopic transvesical Cohen technique is reported with success rates of **91–96%** in one review summary.[4] A guideline synthesis comparing robot-assisted and laparoscopic approaches reported reflux resolution of **92.3%** (laparoscopic) versus **93.3%** (robot-assisted) without serious complications, while also noting complications such as port urine leakage (12.6%) and anastomotic stricture (6.3%) in laparoscopic series reporting those outcomes.[6]

5. Prognostic factors and how each modifies the treatment decision

The factors most directly supported in the provided evidence base are age, sex, VUR grade (including laterality), DMSA renal cortical abnormalities (defects/scarring/deterioration), recurrent febrile UTIs, CAP response (breakthrough), and BBD. These factors appear repeatedly as predictors of spontaneous resolution, risk of UTI recurrence, risk of renal cortical defects, and likelihood of endoscopic success.[1, 8]

5a. Patient age

Age modifies both prognosis and renal-risk associations in the provided sources. EAU/ESPU guidance states that faster resolution is more likely when age at presentation is <1 year, in addition to lower grade and asymptomatic presentation (e.g., prenatal hydronephrosis or sibling screening).[5] In the large DMSA cohort, focal cortical defects were more common in children ≥1 year than in infants <1 year (18% vs 6%, p=0.001), and each additional year of age increased odds of focal defects (OR 1.2; 95% CI 1.1–1.3), suggesting increasing age is associated with higher probability of detectable renal cortical injury in that referral population.[8]

Age also interacts with guideline-recommended CAP selection. EAU/ESPU guidance recommends CAP for symptomatic infants diagnosed within the first year of life regardless of grade or focal uptake defects, while children presenting at 1–5 years are initially managed medically, and low-grade asymptomatic reflux can be observed without prophylaxis.[5]

5b. Sex

Sex influences both epidemiology and outcomes in multiple sources. EAU/ESPU guidance notes that among all children with febrile UTIs, boys are more likely than girls to have VUR (29% vs 14%).[5] In natural history follow-up, overall VUR resolution was higher in boys than girls (39.5% vs 28.0%), and mean age at resolution was younger in boys than girls (5.7 vs 7.5 years).[2]

Sex also modifies infection risk and follow-up outcomes. In the infant high-grade reflux RCT, febrile UTIs during follow-up were more frequent in girls than boys (36% vs 15%), and female sex predicted febrile UTI in univariable logistic regression (independent of treatment group), highlighting a subgroup at higher infection risk even in early infancy high-grade disease.[7] In the Swedish trial data summarized in the guideline review, recurrent UTI incidence was 2–3 times higher among girls in surveillance (57%) compared with antibiotic prophylaxis (19%) and endoscopic (23%) arms, emphasizing that in at least one trial context, girls under surveillance experienced substantially higher recurrent UTI burden than those receiving active prophylaxis or endoscopic correction.[1]

5c. Maximum VUR grade

Across the provided sources, **grade is a dominant prognostic and decision-driving variable**.

First, grade predicts spontaneous resolution. Natural history estimates at birth indicate a steep gradient: ~80% spontaneous resolution for grades I–II, ~50% for grade III, and ~20% for grades IV–V.[1] Another cohort found resolution rates of 85.5% for grade I–II, 45.8% for grade III, and 6.7% for grades IV–V.[2] European guidance similarly reports that resolution is nearly 80% for grades I–II and 30–50% for grades III–V within 4–5 years of follow-up.[5]

Second, grade is strongly associated with renal cortical defects on DMSA. In the DMSA cohort multivariable model, grades IV and V had very high odds of focal defects compared with no VUR (grade IV OR 28.2; grade V OR 84.9).[8]

Third, grade predicts interventional outcomes. In the infant high-grade RCT, endoscopic treatment produced higher downgrading to ≤II at 1 year than CAP (59% vs 21%), but success varied dramatically by unilaterality and baseline grade (100% in unilateral grade 4 vs 31% in bilateral grade 5), demonstrating the combined prognostic significance of grade and laterality for endoscopic outcome expectations.[7] Guideline synthesis also provides grade-stratified endoscopic resolution after one injection (78.5% grade I–II vs 51% grade V).[5]

Finally, grade is a key predictor of recurrent febrile UTI risk in prospective cohort evidence summarized in the sources, with the highest 2-year recurrence rates in grade 3–4 VUR (Kaplan–Meier estimate 28.9%).[4]

5d. Renal cortical abnormalities on nuclear imaging

Renal cortical abnormalities on radionuclide imaging (DMSA or other scintigraphy) operate in the sources both as a marker of renal injury burden and as a risk factor for adverse clinical course.

In the large DMSA study, focal cortical defects (presumed acquired renal damage) were present in 15.5% of children, supporting that renal cortical abnormalities are not rare among referred pediatric populations with VUR and/or febrile UTI.[8] In that cohort, recurrent febrile UTIs (≥2) and high-grade VUR were strongly associated with focal defects (≥2 fUTI OR 3.9; grade IV OR 28.2; grade V OR 84.9).[8] European guidance also notes that focal uptake defects on radionuclide scan are a significant risk factor for breakthrough febrile UTI and may help identify children at risk of persistent symptomatic VUR.[5]

In infants with grade 4–5 reflux, follow-up scintigraphic deterioration was observed (eight children), and febrile UTI episodes between scans were associated with increased probability of renal deterioration (6/8 with fUTI; p=0.003).[7] In guideline summaries, the presence or absence of cortical abnormalities can shift recommended baseline strategy after toilet training: observation is recommended for grade I–II VUR **without cortical abnormalities**, while CAP is recommended for grade III–V VUR **with cortical abnormalities**.[6]

5e. Recurrent febrile UTIs

Recurrent febrile UTI is repeatedly treated as a decisive escalation trigger and a proxy for ongoing renal risk.

Prospective cohort evidence summarized in the sources indicates that, over two years, children with VUR have high risk of febrile UTI recurrence compared with those without VUR, with highest recurrence rates in grade 3–4 VUR (Kaplan–Meier 28.9%).[4] The multivariable model in that cohort summary identified VUR grade/severity, baseline BBD, and baseline kidney scarring as significant correlates of recurrent UTI, aligning with the notion that recurrence risk is multi-factorial but strongly anchored by reflux severity and bladder-bowel function.[4]

The link between infection recurrence and renal outcomes is supported by both observational and randomized infant data: ≥2 febrile UTIs predicted focal DMSA defects (OR 3.9) in a large cohort, and febrile UTIs between scintigraphy assessments were associated with renal deterioration in the infant RCT.[7, 8]

5f. CAP status and breakthrough infection

A key management fork is whether CAP is being used and whether the child experiences **breakthrough febrile UTI** on CAP. AUA guidance summarized in the sources explicitly recommends that patients receiving CAP with a febrile breakthrough UTI be considered for **open ureteral reimplantation or endoscopic injection** with curative intent.[1]

At the population level, RIVUR shows that CAP reduces recurrence risk (HR 0.50 overall; HR 0.21 with BBD) but does not eliminate recurrence or prevent new scarring over two years, which helps explain why breakthrough infections remain clinically meaningful and may prompt definitive correction in selected patients.[3]

5g. Bladder bowel dysfunction

BBD is both common and clinically consequential in the provided evidence base.

Prevalence and phenotype are well described: among toilet-trained children, baseline BBD prevalence was 54%, and 94% of those with BBD reported daytime wetting, withholding maneuvers, or constipation.[10] Meta-analytic estimates similarly report a pooled BBD prevalence of 49% in primary VUR and higher prevalence in females than males (53% vs 44%), with pooled constipation prevalence of 27% in studies reporting constipation separately.[11]

BBD substantially increases recurrent UTI risk. In toilet-trained children not on antimicrobial prophylaxis, recurrent UTI occurred in 51% with both BBD and VUR versus 20% with VUR alone (and 35% with BBD alone).[10] In the RIVUR placebo cohort, risk of recurrent UTI during times with BBD was threefold higher than during times without BBD, and among children with BBD, recurrent UTI proportions were lower with RIVUR prophylaxis (18%) than placebo (51%).[10] Meta-analytic data also report that BBD increases risk of recurrent UTIs in primary VUR (RR 2.1; 95% CI 1.7–2.5).[11]

BBD also alters procedural expectations. Evidence summaries state that BBD does not affect cure rates of open surgical procedures but does affect endoscopic procedures, and guideline synthesis reports that reflux resolution after endoscopic injection is significantly reduced with BBD whereas open surgery resolution is unaffected by BBD.[1, 6] Because of these relationships, European guidance advises evaluation and management of BBD **before any treatment of VUR**, and also suggests a pragmatic CAP duration strategy of continuing CAP until there is no further BBD.[5]

6. Integrated treatment algorithm

A practical, evidence-aligned algorithm can be framed as a stepwise escalation pathway that explicitly integrates the prognostic factors above.

First, stratify by reflux severity and infection history, because grade predicts spontaneous resolution, endoscopic success, and renal cortical defect risk. Spontaneous resolution is high for grades I–II (~80% within several years) and much lower for grades IV–V (~20% at birth; ~6.7% in one cohort), supporting initial observation/medical strategies in

many low-grade cases and a lower threshold to intensify management in high-grade cases.[1, 2] Grade IV–V is also strongly associated with focal DMSA defects (grade IV OR 28.2; grade V OR 84.9) in a large cohort, reinforcing the higher renal-risk profile of dilating reflux.[8]

Second, systematically assess and treat BBD in toilet-trained children (and address bladder-bowel symptoms broadly), because BBD is common, doubles recurrent UTI risk in primary VUR, and increases recurrence risk dramatically when combined with VUR; European guidance explicitly recommends BBD evaluation and management before reflux-directed treatment.[5, 10, 11]

Third, choose initial management based on age and symptoms, using guideline anchors.

- **Symptomatic infants diagnosed in the first year of life**: EAU/ESPU guidance recommends CAP regardless of reflux grade or focal uptake defects on radionuclide scan.[5]
- **Children presenting at age 1–5 years**: EAU/ESPU guidance recommends initial medical management, and low-grade asymptomatic reflux can be managed with close surveillance without antibiotic prophylaxis.[5]
- **Toilet-trained children**: observation is recommended for grade I–II VUR without cortical abnormalities, while CAP is recommended for grade III–V VUR with cortical abnormalities in the guideline summary provided.[6]

Fourth, escalate based on febrile UTI recurrence and renal imaging.

- **Consider CAP to prevent recurrent UTI**, especially in higher-risk groups, informed by RIVUR (overall HR 0.50; larger benefit with BBD HR 0.21) and by the observation that BBD+VUR without prophylaxis carries high recurrence (51%).[3, 10]
- **If febrile breakthrough UTI occurs on CAP**, AUA guidance recommends considering curative-intent intervention (open reimplantation or endoscopic injection).[1]
- **If renal cortical abnormalities or scintigraphic deterioration are present**, recognize the associated risk context: focal uptake defects are cited as a risk factor for breakthrough febrile UTI, and febrile UTIs between scans correlate with renal deterioration in infants with high-grade reflux.[5, 7]

Finally, select the intervention modality based on patient risk profile and expected durability.

- **Endoscopic injection** is supported by single-injection success around 70–90% in review summaries, meta-analytic single-injection success of 83.0%, and grade-stratified success declining in grade V (51% after one injection), but requires counseling about recurrence (median 26%) and febrile UTI after injection (0–21%).[1, 4, 5]
- **Open (or minimally invasive) reimplantation** offers the highest cure rates (open ~98.1% and commonly 95–99% in primary VUR) and is reported as highly effective even in the setting of functional abnormalities such as BBD, with minimally invasive approaches also showing high resolution rates (e.g., laparoscopic Cohen 91–96%; robot-assisted ~93.3%).[1, 4, 6]

7. Guidelines and areas of continuing controversy

Guideline direction in the provided sources illustrates the evolution from empiric universal prophylaxis toward risk-based selection.

Historically, the AUA 1997 panel recommended CAP as initial therapy for children with reflux grades I–IV, but the same source explicitly notes the recommendation was **based on expert opinion rather than clear scientific evidence**.[12] In contrast, European guidance emphasizes that CAP may not be necessary for every child, recommends surveillance without prophylaxis for asymptomatic low-grade reflux, and provides age-stratified initial management statements (e.g., CAP for symptomatic infants in the first year of life regardless of grade).[5]

A second major theme is the tension between **reducing recurrent UTI** and **demonstrating renal outcome benefit**. RIVUR shows a large recurrence reduction (HR 0.50; absolute reduction 12%) but no between-group difference in new renal scarring over two years, and other long-term comparisons summarized similarly report no difference in new renal scarring between antibiotic prophylaxis and open surgery even while febrile UTI recurrence differs.[1, 3] Trials such as PREDICT show modest first-UTI prevention benefit in selected infants (NNT 7 over 2 years) without differences in kidney scarring/function/hospitalization, while also increasing resistance and non–E. coli organisms, intensifying the stewardship and risk-benefit conversation with families.[5]

A third area of ongoing practical debate is the comparative role of endoscopic injection versus CAP in high-grade infant reflux. In the infant RCT, endoscopic therapy achieved substantially greater downgrading to ≤II than CAP at 1 year (59% vs 21%) but did not differ from CAP in bladder function, UTI recurrence, or renal scarring outcomes over the trial period, suggesting that radiographic improvement does not necessarily translate into short-term clinical or renal endpoints in that population.[7]

8. Key takeaways

Clinical decision-making can be summarized as a few high-yield, evidence-supported principles.

- **Spontaneous resolution is common in low-grade VUR** and decreases steeply with increasing grade, supporting observation/medical strategies in many children with grades I–II and careful counseling for higher-grade reflux persistence.[1, 5]
- **VUR grade is a dominant prognostic factor**, predicting spontaneous resolution, endoscopic success, and renal cortical defect risk on DMSA imaging (e.g., grade V OR 84.9 for focal cortical defects vs no VUR in one cohort).[5, 8]
- **CAP reduces recurrent UTI risk** in RIVUR (HR 0.50 overall; absolute risk reduction 12%), with particularly strong relative benefit in children with BBD (HR 0.21).[3]
- **CAP does not clearly reduce new renal scarring over two years in RIVUR**, emphasizing that the principal demonstrated benefit is UTI prevention rather than proven short-term scarring reduction.[3]
- **Antibiotic resistance increases with CAP** in RIVUR-related summaries (e.g., E. coli resistance 63% vs 19% in treated vs placebo recurrences), making stewardship a central part of counseling and follow-up.[3]
- **BBD is common and increases recurrent UTI risk**, particularly in combination with VUR (e.g., 51% recurrence with BBD+VUR off prophylaxis vs 20% with VUR alone).[10]
- **Treat BBD before reflux-directed intervention**, consistent with European guidance, because BBD contributes to recurrence risk and reduces endoscopic success while not affecting open surgery cure rates.[1, 5]
- **Breakthrough febrile UTI on CAP is a major escalation trigger**, with AUA guidance recommending consideration of endoscopic injection or open reimplantation for curative intent in that scenario.[1]
- **Endoscopic injection offers minimally invasive correction with moderate-to-high short-term success** (meta-analytic single-injection success 83.0%; grade V ~51% after one injection) but requires counseling on recurrence (median 26%) and variable post-procedure UTI rates (febrile UTI 0–21%).[1, 5]
- **Open reimplantation provides the highest cure rates** (estimated ~98.1%; commonly 95–99% in primary VUR) and is effective even in functionally complex patients, while minimally invasive approaches also report high resolution (e.g., laparoscopic Cohen 91–96%; robot-assisted 93.3%).[1, 4, 6]

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