



Cystogram
illustrating bilateral
ureteral reflux in
6-year-old girl.

catheterization and by using closed-circuit drainage systems.⁸

DIAGNOSIS OF BACTERIURIA

Pour-plate technique. The accepted methodology for diagnosing a significant urinary tract infection is quantitative bacteriology; the standard procedure for counting bacterial colonies is the pour-plate technique. According to this method, either blood agar or MacConkey's agar plates are inoculated with aliquots of undiluted urine obtained with standardized sterile loops or pipettes, preferably within minutes of voiding. Plates are incubated overnight at 37°C, with blood agar in an atmosphere of increased CO₂ tension. Colonies are counted the next day. It is recognized that this standard laboratory technique is liable to variation and error. This has led to the evaluation of other diagnostic methods, many of which provide accurate bacteriologic information and are also convenient and economical.

Dip slides. Brumfitt²⁴ described a simple diagnostic method using a strip of sterile filter paper that is first dipped in urine, then placed on a small agar container and incubated. This technique provides good results, but the differentiation between "doubtful" and "negative" findings is frequently difficult. The dip slide appears to provide the best approach to a fully quantitative method. Dip slides, now available from various manufacturers, have essentially the same design consisting of a glass or plastic slide coated on both sides with nutrient agar or an inhibitory selective agar. Slides are inoculated immediately after urine collection and incubated overnight in their sterile containers. Bacterial colony counts are then estimated by comparing them with the colony density depicted on manufacturers' charts. Dip-slide testing has been extensively evaluated in adults and children; results compared favorably with the pour-plate technique used as control.^{3,25-27} A more recent innovation is the application of antibiotic sensitivity discs to the lower end of the dip slide prior to incubation.²⁷ A zone of inhibition around the disc indicates that the organism is sensitive to that antibiotic. Thus, the practitioner

may obtain both diagnostic and therapeutic information within 24 hours of urine collection.

Chemical method: glucose oxidase test. Chemical methods have also been developed for diagnosing bacteriuria. Scherstén and Fritz²⁸ used the fact that urinary glucose concentrations of less than 0.1 $\mu\text{mol/l}$ occur in the presence of significant bacteriuria provided that: a) the patient is fasting; b) the urine has remained in the bladder for 4-6 hours. Low urinary glucose concentrations can be detected by a commercially available paper-strip test reagent (glucose oxidase) that reflects the small amounts of sugar utilized during bacterial multiplication. A negative result is indicated by the blue color that develops within 10 minutes, while a positive result—equivalent to a urinary glucose concentration lower than 0.1 $\mu\text{mol/l}$ —is indicated by the absence of a color change. This test's major drawback is that it requires a urine sample from a fasting patient; failure to adhere to this requirement leads to false-negative results, undesirable in any screening device. For example, in one recent survey of schoolgirls screened for bacteriuria,³ the glucose-oxidase test strip indicated a false-negative result in 20.8% while the dip-slide technique produced no false-negatives.

Chemical method: nitrite test. Still another chemical test is based on the observation that the Griess reagent turns pink in the presence of nitrite formed during the reduction of urinary nitrate by certain gram-negative pathogens such as *Escherichia coli*. This commercially available test can detect 60-70% of cases of significant gram-negative bacteriuria.^{29,30} Sensitivity is enhanced by withholding micturition for a few hours, and also by waiting at least one minute before interpreting the test result.²⁹ This method is far from ideal, as—in the author's experience—approximately 30-40% of false-negative results can be anticipated. False-positive results are infrequent.²⁹ According to a recent report by Kunin,³¹ self-administration of the nitrite test by women who participated in a screening program resulted in 90% detection of those with bacteriuria when three different