The urine dipstick test useful to rule out infections: a meta-analysis of the accuracy

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CRD summary
This review assessed the diagnostic accuracy of urine dipstick tests for detecting urinary tract infection. The authors concluded that negative results for both leukocyte esterase and nitrite appear to rule out disease in all populations, but that positive results require confirmation. This was a well conducted and presented review, and the authors’ conclusions are likely to be robust.

Authors’ objectives
To summarise the available evidence on the diagnostic accuracy of urine dipstick tests for the detection of urinary tract infection (UTI).

Searching
MEDLINE and EMBASE were searched from 1990 to January 2000; the full search strategies were reported online (see Web Address at end of abstract). Additional references were sought through reference tracking and contact with experts in the field. No language restrictions were applied.

Study selection
Study designs of evaluations included in the review
No inclusion criteria for the study design were specified. All included studies appeared to be diagnostic cohorts.

Specific interventions included in the review
Studies investigating the use of dipstick tests to detect the presence of nitrites and/or leukocyte esterase, in order to diagnose bacteriuria or UTI, were eligible for inclusion. Studies that focused on urethritis, schistosomiasis or sexually transmitted diseases, and studies that reported results for nitrite and/or leukocyte esterase in combination with other tests, were excluded.

Reference standard test against which the new test was compared
Studies that used semi-quantitative or quantitative urine culture as the reference standard of diagnosis were eligible for inclusion. The included studies defined a positive reference standard as any growth, 1,000 mcu/mL, 10,000 mcu/mL or 100,000 mcu/mL, depending on the urine sampling method used. The urine sampling methods included suprapubic aspiration, catheterisation, mid-stream collection and bag collection.

Participants included in the review
No inclusion criteria were specified for the study participants. The included studies were conducted in in-patient, out-patient and community settings, and included urology patients, children, pregnant women and elderly patients.

Outcomes assessed in the review
The included studies were required to report sufficient data for the construction of 2x2 contingency tables. The sensitivity, specificity and diagnostic odds ratio (DOR) were calculated for the individual studies included in the review.

How were decisions on the relevance of primary studies made?
Two reviewers selected studies for inclusion. When consensus was not reached a third reviewer was consulted.

Assessment of study quality
The checklist of the Cochrane Screening and Diagnostic Tests Methods Group was used to assess and score the methodological quality of the included studies. Subtotals were calculated for internal validity (maximum score 8) and external validity (maximum score 16), along with the percentages of maximum possible scores with 95% confidence.
intervals (CIs). Three reviewers independently assessed study quality. Any disagreements were resolved in consensus meetings.

Data extraction
The authors did not state how the data were extracted for the review, or how many reviewers performed the data extraction. Detailed data were extracted on study setting, participant selection and characteristics, methods of urine sample collection and transport, methods of analysis and definition of infection.

Methods of synthesis
How were the studies combined?
The sensitivity, specificity and DOR were pooled after natural logarithmic (ln) transformation, using the method of Moses and Littenberg (see Other Publications of Related Interest). Where sensitivity and specificity were negatively correlated and lnDOR showed no evidence of heterogeneity, a summary receiver operating characteristic curve was fitted.

How were differences between studies investigated?
The statistical heterogeneity of the sensitivity, specificity and DOR values was evaluated using a chi-squared test. Regression analyses and subgroup analyses were used to investigate predefined, potential sources of heterogeneity.

Results of the review
A total of 72 data sets from 70 studies (84,396 samples) were included in the review.

The included studies had a mean score of 72% (95% CI: 69, 75) for internal validity and 69% (95% CI: 65, 73) for external validity. Most of the studies did not provide information on mixed or contaminated cultures.

The sensitivity of nitrite testing was generally low (45 to 60%) with higher specificity (85 to 98%). The accuracy was influenced by the cut-off value and the type of population. The overall accuracy of nitrites was highest in pregnant women (DOR 165, 95% CI: 73, 372) and in the elderly (DOR 108, 95% CI: 10, 1,165). Positive predictive values for nitrites were greater than or equal to 80% in elderly people and in family medicine.

Compared with nitrites, sensitivity was slightly higher with leukocyte-esterase (48% to 86%) and specificity was slightly lower (17 to 93%). Differences between the studies were due to external validity factors. The overall accuracy of leukocyte esterase was highest in studies of urology patients (DOR 276, 95% CI: 2, 41,974), and sensitivities were highest in family medicine (87%, 95% CI: 83, 92).

Negative predictive values were high for both tests in all patient groups and settings, except for family medicine.

Combined leukocyte esterase and nitrite tests (one or both positive equals a positive result) produced generally increased sensitivities and had varying effects on specificities. Using this combination, overall accuracy was high in urology patients (DOR 52, 95% CI: 48, 56), children (DOR 46, 95% CI: 23, 95) and where clinical information was present (DOR 28, 95% CI: 18, 44). Sensitivity was highest in family medicine (90%, 95% CI: 89, 92). Predictive values of combined tests were low in all other situations.

Authors' conclusions
Urine dipstick alone appears useful for excluding the presence of infection in all populations where both leukocyte esterase and nitrite are negative. The sensitivities of the combined tests (where one or both are positive was defined as a positive test) varied between 68 and 88%, depending upon the patient group, but positive tests require confirmation. This combination of positive test results is very sensitive in family practice. However, the usefulness of dipstick tests in ruling in infection remains doubtful, even in high prevalence populations.

CRD commentary
Overall, this was a well-conducted and clearly reported review. It addressed a clearly stated question and the inclusion criteria were well defined. Electronic searches were restricted to MEDLINE and EMBASE (the full search strategies were reported online), and this might have resulted in some relevant studies being missed; the impact of searching multiple databases on the 'pick-up rate' in systematic reviews of diagnostic accuracy studies remains unknown. The included primary studies were quality assessed using appropriate published criteria, and measures were taken to minimise the introduction of bias and error during the review process. Appropriate pooling methods were used and these were well described; potential sources of heterogeneity were predefined and rigorously investigated. The authors' conclusions follow from the data presented, though CIs for the pooled DORs were generally wide and this should be considered when using them as an indicator of overall diagnostic performance.

Implications of the review for practice and research
Practice: Urine dipstick test alone appears useful to exclude the presence of infection in all populations if both leukocyte esterase and nitrite are negative. Positive test results need to be confirmed, or pre-test probabilities need to be high based on clinical history and/or other tests.

Research: The authors stated that research in the field could be improved by clear inclusion and exclusion criteria; double-blind study designs; reporting on the distribution of micro-organisms, urine sampling methods, time delay between collection and analysis, handling of mixed cultures and contamination, and test readers; and the publication of results for relevant subgroups, where sample sizes are adequate.

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