Accuracy of Gram-stained smears as screening tests for *Neisseria gonorrhoeae*: Brief communication

Sir,

Neisseria gonorrhoeae (Ng) is an etiologic agent of gonorrhea, one of the most common sexually transmitted diseases caused by bacteria. Which has an estimated global annual incidence of 86.9 million adults.[1] A presumptive gonorrhea diagnosis can be made based on light microscopic detection of the bacterium in Gram-stained smears (GSS). This enables immediate treatment, thus preventing ongoing transmission and/or loss to follow-up.[2]

The present study reviewed the diagnostic accuracy variables (sensitivity, specificity, likelihood ratios [LRs], and diagnostic odds ratios [DORs]) of gram GSS that screen for *Ng* in urethral swabs and endocervical swabs specimens. Author evaluated studies conducted worldwide in adults by searching

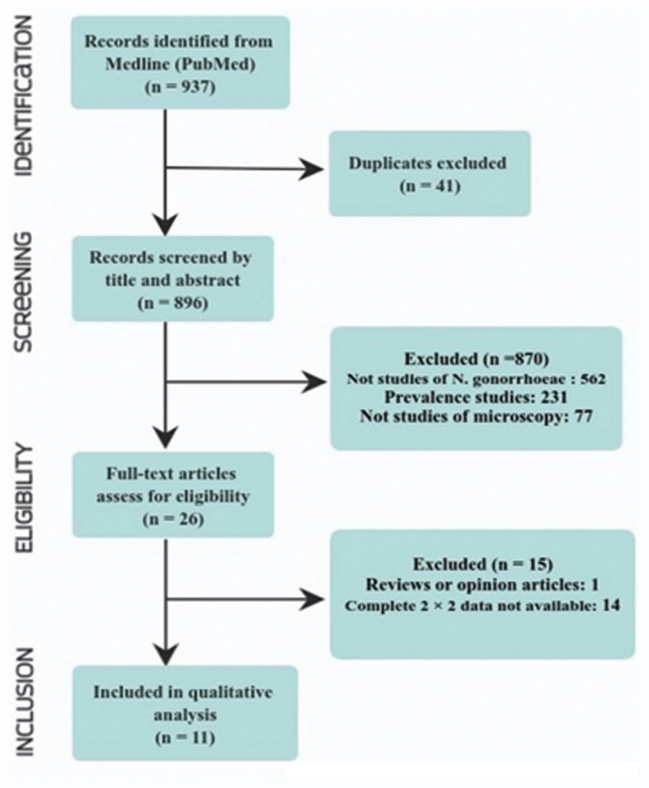

Figure 1: Study flow diagram. Data extraction and quality assessment

Table 1: Sensitivity and specificity from each study

Study	Sensitivity (95% CI), %	Specificity (95% CI), %
Bhargava *et al.*, 2017[3]	95 (93-97)	99 (99-99)
Goodhart *et al.*, 1982[4]	70 (63-76)	85 (79-89)
Taylor *et al.*, 2011[5]	99 (93-100)	99 (97-100)
Goh *et al.*, 1985[6]	90 (88-91)	98 (97-98)
D'Angelo *et al.*, 1987[7]	56 (42-69)	99 (98-100)
Orellana *et al.*, 2007[8]	80 (61-92)	90 (87-93)
Bartelsman *et al.*, 2011[9]	86 (83-87)	100 (100-100)
Borg *et al.*, 2017[10]	91 (76-98)	64 (55-71)
Juchau *et al.*, 1995[11]	100 (99-100)	100 (99-100)
Hun *et al.*, 2017[12]	90 (74-98)	95 (87-99)
Hananta *et al.*, 2017[13]	53 (43-62)	89 (86-92)

CI=Confidence interval

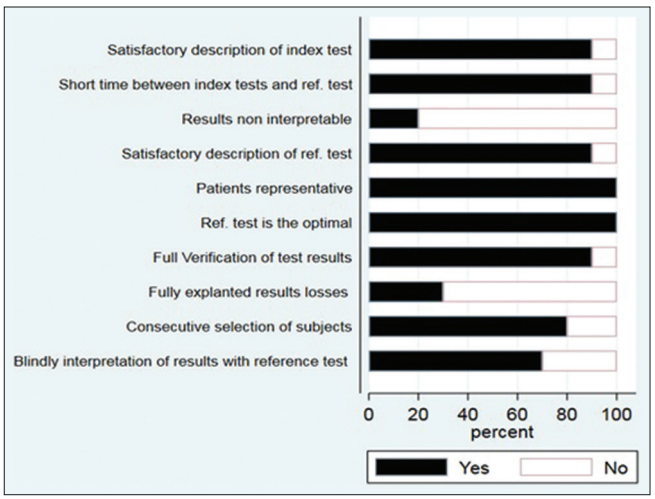

Figure 2: Quality assessment of diagnostic accuracy studies assessments

Table 2: Results of meta-analysis, by specimen and reference standard subgroup

Subgroup	Pooled sensitivity (95% CI), %	Pooled specificity (95% CI), %	Positive LR (95% CI)	Negative LR (95% CI)	DOR (95% CI)
GSS verse culture methods	87 (74-94)	98 (95-100)	55.9 (16-196)	0.13 (0.06-0.28)	417 (78-2226)
GSS verse NAAT	93 (64-99)	94 (73-99)	16.2 (2.7-96)	0.07 (0.01-0.52)	225 (6-7842)
Gram-stained urethral smears	97 (86-100)	96 (78-99)	25.9 (3.7-180.7)	0.03 (0.00-0.17)	901 (24-33445)
Gram-stained endocervical, urethral swabs and urine smears	81 (67-90)	98 (93-99)	40.8 (11.5-143.8)	0.19 (0.10-0.36)	215 (41-1126)

DOR=Diagnostic odds ratio, LR=Likelihood ratio, GSS=Gram-stained smears, NAAT=Nucleic acid amplification tests, CI=Confidence interval

MEDLINE (through PubMed) from 1980 to 2020. This study included studies conducted in adult humans if they provided enough raw data to recreate the 2 × 2 diagnostic tables. The author did not exclude articles on the basis of study location or study design. Figure 1 shows a flowchart of the search. The author conducted the searches and screened articles for eligibility. After initial identification of all studies and deletion of duplicates, the author did a preliminary screening of 937 articles based on title and abstract. Of which, 26 were considered for full-text review. Eleven articles were retrieved and included in the study.

The present study assessed the methodological and reporting quality of studies using the (Quality Assessment of Diagnostic Accuracy Studies 2) tool [Figure 2]. All statistical analyses were carried out in Intercooled Stata, version 15 (StataCorp, College Station, Texas, USA). The sensitivity, specificity, positive LR, negative LR, and DOR were calculated [Tables 1 and 2]. LRs of a test inform the pretest probability of disease and provide a posttest probability. A positive LR higher than 5 and a negative LR <0.2 provide strong diagnostic evidence.[14]

Of the 11 total studies, 3 (27%) were conducted in developing settings[3,12,13] and 8 (73%) were conducted in developed settings.[4-11] Sample sizes ranged from 95 to 27,600 persons.

To interpret study results, first, reference standards were found to influence the accuracy of GSS.[15] Second, the effect of antimicrobial susceptibility testing on diagnostic accuracy is worth further consideration.[16] Third, the index tests included in this study detected intercellular diplococcus Ng and therefore could not detect infection within about 2–10 days.[17] Finally, evidence on GSS will be of greater use to policymakers and guideline developers if outcomes beyond accuracy are documented.

In conclusion, GSS offers many advantages: A fast turnaround time, declaration of results at the point of care with the potential for affecting clinical management, and early detection of undiagnosed cases of gonorrhea.[18] This study found GSS to be accurate and suitable for screening initiatives.

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Conflicts of interest
There are no conflicts of interest.

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