Choosing a gold standard: support of Bayesian inference methods for diagnostic accuracy of new biomarkers in pediatric urinary tract infection

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Background. Acute pyelonephritis (APN – kidney infection) is a common pediatric bacterial infection. Biomarkers-based strategies (e.g. procalcitonin) aimed at promptly diagnosing APN, and were compared with DMSA scan, whose gold-standard quality raises concerns. We used for the first time Bayesian methods to estimate the diagnostic accuracy of procalcitonin and DMSA.

Methods. We used a Bayesian approach to explore disease prevalence and tests properties, using an independent model and both fixed and random effects models with conditional dependence between tests [1-2]. Two levels of prior distribution were defined: one informative obtained from a published meta-analysis of individual patient data (1011 patients, 61% APN) [3] and pediatrician beliefs for DMSA, and one non-informative. Standard procedures [4] were used to achieve MCMC convergence (trace and density estimate, Gelman and Geweke criteria, autocorrelation function), for model checking (DIC, posterior predictive checking) and for a sensitivity analysis. All analyses were performed using R and OpenBugs softwares [5] and Brugs, R2OpenBugs and Coda packages.

Results. With the informative prior, the fixed model yielded for procalcitonin a sensitivity of 74% [71-77] and specificity of 70% [66-74], and for DMSA a sensitivity of 94% [87-98] and specificity of

90% [80-97]. With the non-informative prior, it achieved a sensitivity of 72% [59-90] and a specificity of 75% [53-94] for procalcitonin, and a sensitivity of 77% [64-92] and a specificity of 74% [50-94] for DMSA. Given the important amount of the additional information contained in prior samples, the non-informative prior seemed sounder. The same discordance between the priors was similarly observed with the independent model. A random effect model will be completed to further explore this result.

Conclusion. A Bayesian approach allowed showing that the gold-standard test for APN, DMSA, was not perfect despite clinical beliefs. Support of Bayesian inference methods for diagnostic accuracy of new biomarkers should be fostered.

Références

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