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External Quality Control Results of Urine Dip-Slide Devices*

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Abstract
Urinary tract infections are frequently diagnosed by using urine dip-slide devices, especially in medical practices and small laboratories. We performed a retrospective analysis of more than 3,000 results obtained by several urine dip-slide devices during external quality control surveys. We found that an underestimation of bacterial counts and a difficulty in identifying mixed flora were relatively more frequent in medical practices than in specialised laboratories, and that regular participation in external quality control surveys correlates with better performances.

Introduction
Urinary tract infections (UTI) are common infectious diseases which affect all age groups. Since urine can be readily obtained, its analysis is frequently performed in laboratories, thus accounting for an important workload. As alternatives to traditional cultures performed on blood agar and selective agar plates, many urine dip-slide devices are available and are well adapted to small laboratories such as medical practices. These devices are easy to handle and are therefore widely used, particularly in Swiss medical practices as well as in specialised laboratories.

Methods
The participants regularly received one or two sets of quality control samples accompanied by a data reply sheet. They did not know the content of the samples and had to determine, with the kits they routinely use, the bacterial CFU/ml and whether the culture was pure or mixed. Each control sample set consisted of three vials: the first vial contained lyophilised bacteria (dark particles) in a transparent cap, the second contained the rehydration buffer, and in the third bottle, 99 ml of buffer solution was provided.
The following information was required: the method used (name of the manufacturer and of the kit), the CFU/ml (growth absence, 10^3, 10^4, 10^5, and 10^6 CFU/ml) and the type of culture (pure culture or mixed flora).
Two types of samples were sent containing either low bacterial counts (10^4 CFU/ml) or high bacterial counts (≥ 10^5). The ability of participants to distinguish pure from mixed cultures was determined with distributions containing one or maximum two different microbial species.
For internal quality control purposes we selected 33 reference laboratories. For each sample, the results of the bacterial count and of the type of culture returned by all the participants were validated and analysed only if the percentage of correct results reported by this group was >70.
The results were separately analysed for two categories of participants, namely those obtained by specialised laboratories in bacteriology (from small private laboratories to university hospital laboratories) and those obtained from medical practices.

Results and discussion
For samples containing **≥ 10^5 CFU/ml**, specialised laboratories obtained, on average, 87.3% of correct answers, 10.8% of underestimated bacterial counts (≤ 10^4), and 1.9% of growth absence, whereas medical practices obtained, on average, 70.9% of correct answers, 25.7% of underestimated bacterial counts (≤ 10^4), and 3.5% of growth absence.
For samples containing **10^4 CFU/ml**, specialised laboratories obtained on average 71.0% of correct answers, 24.8% of overestimated bacterial counts (≥ 10^5), and 4.2% of growth absence, whereas the medical practices obtained, on average, 71.4% of correct answers, 12.8% of overestimated bacterial counts (≥ 10^5), and 15.8% of growth absence.
For samples containing **pure cultures**, specialised laboratories obtained, on average, 92.0% of correct results whereas medical practices obtained on average 83.7% of correct answers. On average, 9.2 % of specialised laboratories did not report the type of culture and this percentage reached 20.5 for medical practices.
For samples containing a **mixed flora**, specialised laboratories obtained, on average, 82.9% of correct results whereas medical practices obtained on average 65.0% of correct answers. On average, 5.5% of specialised laboratories did not report the type of culture, and this percentage reached 13.1 for medical practices.
Specialised laboratories tended to slightly overestimate the bacterial counts (CFU/ml) whereas medical practices tended to underestimate the quantification. In several cases, the reported insufficient growth was due to the incubation of the dip-slides at room temperature. In other cases, the reading of the dip-slides was performed before 24h of incubation. Other factors that can lead to errors include the temperature of the incubator that was not carefully controlled (temperatures < 35°C can reduce the growth of temperature-sensitive species), the reading of the dip-slide with an insufficient light source or after more than 48 h of incubation, the use of an expired dip-slide, the improper storage of the dip-slide, and the presence of condensation water on the agar slide surface.
We found a positive correlation between the number of analyses performed and the number of correct results obtained.

Comparison of performances of specialised laboratories and medical practices in determining bacterial counts

Survey year	CFU/ml	Organisms	No. of results			Bacterial counts: Correct (%)		Underestimated (%)		Overestimated (%)		Growth absence (%)	
			Specialised Laboratories	Medical Practices	Both	Specialised Laboratories	Medical Practices	Specialised Laboratories	Medical Practices	Specialised Laboratories	Medical Practices	Specialised Laboratories	Medical Practices
2001	≥ 10^5	*Enterococcus faecalis*	83	95	178	83.1	66.3	15.7	30.5	-	-	1.2	3.2
		Klebsiella oxytoca	82	95	177	95.1	81.1	2.4	18.9	-	-	2.4	0
		Staphylococcus epidermidis + Escherichia coli	86	91	177	91.9	70.3	5.8	26.4	-	-	2.3	3.3
2002		*Proteus vulgaris*	91	139	230	90.1	74.8	4.4	11.5	-	-	5.5	13.7
		Pseudomonas aeruginosa + Enterococcus faecalis	98	147	245	92.9	74.1	7.1	25.9	-	-	0	0
		Klebsiella oxytoca	98	148	246	82.7	59.5	15.3	38.5	-	-	2.0	2.0
2003		*Escherichia coli*	104	233	337	96.2	94.8	2.9	3.4	-	-	1.0	1.7
		Enterococcus faecalis	99	227	326	74.7	54.2	24.2	42.7	-	-	1.0	3.1
		Enterococcus faecalis + Escherichia coli	99	263	362	78.8	62.7	19.2	33.1	-	-	2.0	4.2
		Total and Mean	840	1,438	2,278	87.3	70.9	10.8	25.7	-	-	1.9	3.5
2001	10^4	*Proteus vulgaris*	86	90	176	72.1	57.8	-	-	17.4	10.0	10.5	32.2
2002		*Candida albicans + Escherichia coli*	91	139	230	63.7	82.7	-	-	35.2	14.4	1.1	2.9
2003		*Pseudomonas aeruginosa + Proteus mirabilis*	101	266	367	77.2	73.7	-	-	21.8	13.9	1.0	12.4
		Total and Mean	278	495	773	71.0	71.4	-	-	24.8	12.8	4.2	15.8
		Overall Total	1,118	1,933	3,051								

Conclusions
Although urine dip-slide devices are easy to handle and widely used, the results presented here strongly suggest that users should have a solid continuous education in microbiology in order to manipulate the devices correctly and to interpret the results accurately to contribute to optimal patient care. Otherwise, the risk of underestimation of the bacterial count and the difficulty in identifying potential contamination was shown not to be negligible.