



# Journal of Medical Sciences

ISSN 1682-4474

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**JMS (ISSN 1682-4474) is an International, peer-reviewed scientific journal that publishes original article in experimental & clinical medicine and related disciplines such as molecular biology, biochemistry, genetics, biophysics, bio-and medical technology. JMS is issued eight times per year on paper and in electronic format.**

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J. Med. Sci., 7 (4): 655-659  
15th May, 2007

## **Comparison of Proficiency Testing among Hospitals Microbiology Laboratories in Tehran and Districts**

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**Abstract:** External quality assessment is one of the important ways for assessment of competency in microbiology laboratories. The aim of this study was to compare external quality assessment results among hospital microbiology laboratories both in governmental and private sectors located in Tehran and districts. Two unknown species of bacteria including *Burkholderia cepacia* and *Staphylococcus epidermidis* were distributed among 121 laboratories including 79 governmental and 42 private sector microbiology laboratories. We asked for identification of both microorganisms and susceptibility testing for *S. epidermidis*. We obtained answer from 106 microbiology laboratories. Nearly all laboratories produced correct answer for identification and susceptibility testing of *S. epidermidis*. However microbiology laboratories in both sector had problems for identification of *B. cepacia*. Governmental related hospital microbiology laboratories in comparison of private sectors produced relatively correct answer for identification of *B. cepacia*. It is concluded that in present country there are difficulties for identification of some microorganism in microbiology laboratories especially in private sectors.

**Key words:** External quality control, microbiology laboratory

## INTRODUCTION

The implementation of clinical governance will require a redefinition of duties and accountability as a prerequisite to develop and achieve an overall improvement in clinical care through a culture of assessment and monitoring of quality. External Quality Assessment Scheme (EQAS) is the main tool enabling laboratories to measure the quality result; they must carefully assess and monitor all elements contributing to the formation of laboratory information (Sciacoverlli *et al.*, 2006).

(EQAS) is a component of quality in which laboratories participating in the program receive EQAS specimen at regular intervals, evaluate them by routine methods and report the results to the organizing center. In addition, EQAS are educational tool that improves national and regional standards (Isenberg, 2004; Mahoon and Manuselis, 2000; Washington *et al.*, 2006; Schal, 1994; Vandepitte *et al.*, 1991).

The Iranian national External Quality Assessment Scheme (EQAS) for microbiology was introduced in 1994 to serve the needs of Iranian microbiology laboratories in both governmental and private sectors. The scheme covers a wide repertoire of clinical microbiology including identification and susceptibility testing. We annually perform three run of external quality assessment program. In microbiology laboratories various steps have been taken to upgrade the EQAS program. These included running national training courses for trainers, sending unknown specimens at regular intervals to the laboratories of the national network and sending standardized methods to control and check the culture media and antibiotic disks.

In spite of regular performing EQAS programs in present country many microbiology laboratories are not able for identification some microorganisms. Present recent study (Abbassi *et al.*, 2006) showed that nearly one third of microbiology laboratories were able to identify three unknown microorganisms including *Acinetobacter baumannii*, *Enterococcus faecalis* and *Enterobacter agglomerans*. In present study we performed a multicenter study in Tehran and districts on proficiency testing for identification and susceptibility testing of two unknown microorganisms. We also compared results obtained from microbiology laboratories in governmental and private sectors.

## MATERIALS AND METHODS

This study carried out from March 2003 to August 2004 in reference laboratories of Iran for assessment of

competency and comparison external quality control results among hospital microbiology laboratories located in Tehran and district in governmental and private sector, we decided to send two unknown organism for identification and susceptibility testing. These species included 1-*Staphylococcus epidermidis* (ATCC 12228) and *Burkholderia cepacia* (ATCC 25416) (part of BD Diagnostics, New Jersey, USA). Before distributing, the species were identified and confirmed by Gram-stain and conventional biochemical tests (Isenberg 2004; Washington *et al.*, 2006). We performed susceptibility testing for *Staphylococcus epidermidis* against ampicillin, tetracycline, cefotaxim, erythromycin and cholamphenicol by methods as recommended by National NCCLS (2002).

Bacterial species were cultured in Trypticase Soy Agar (TSA) medium in screw capped tubes. They were incubated in 35°C for 24 h. After confirming the growth of cultures; specimens were placed in specially designed package containing instructions and other paperwork. Post mail shipments were labeled in accordance with post carrier regulation. The laboratories asked to identify both organisms and perform susceptibility testing for sample 2 and record the zone of inhibition and interpret with regard to standard method and categorize them as susceptible (S), intermediate susceptibility (I) and resistant (R).

Laboratories are required to report within a deadline, the identities and relevant antimicrobial susceptibility testing of organisms. In this study we distributed two unknown sample (containing two strains of bacteria) between 121 (79 governmental and 42 private sector) hospitals microbiology laboratories located in Tehran.

Scoring of results performed according of WHO criteria. The maximum score of point for identification of each bacterium was 3 and 5 for susceptibility testing (Vandepotte, 1998). The results were analyzed by using SPSS.

## RESULTS

Of 121 hospital laboratories we received answer from 106 (91.3%) laboratories. Of 77 governmental hospital microbiology laboratories 69 laboratories participated in present program, which 65 laboratories produced correct answer for identification of *S. epidermidis* and obtained 3 score of point. Four laboratories obtained intermediate score (0.5-2.5). The mean score of points in this group of laboratories was 2.88 (SD±0.58). For identification of *S. epidermidis* in private sector hospital microbiology laboratories, 32 laboratories produced correct answer for identification of *S. epidermidis* and obtained 3 score of points and only three laboratories produced incorrect answer and obtained zero score of point. Two laboratories

Table 1: Comparison of external quality assessment among hospital microbiology laboratories in governmental and private sector for diagnosis of organisms in Tehran and districts

Organisms	Sector	Mean	SD	Correct answer	Incorrect answer	Partial correct answer
<i>S. epidermidis</i>	Governmental	2.88	0.98	65	0	4
	Private	2.65	0.91	32	3	2
<i>B. cepaciae</i>	Governmental	1.45	1.2	24	24	21
	Private	0.95	1.1	7	17	13

produced partial correct answer and obtained 0.5-2.5 score of point. (Table 1). The main score of points in this group laboratories was 2.8 (SD±0.7376) Statistically there was no significant difference between two groups of laboratories (t-test p-value =0.712) for identification *S. epidermidis*. Of 69 governmental hospital's microbiology laboratories 24 laboratories completely identified *Burkholderia cepacia* and obtained 3 score of points and also 24 laboratories produced completely wrong answer for identification of *B. cepacia* and obtained zero score of points. The remaining 21 laboratories obtained 0.5-2.5 score of points (Table 1). The mean score of points for identification of *B. cepacia* was 1.45 (SD±1.2). Of 37 private sector hospital's microbiology laboratories only 7 laboratories produced completely correct answer for identification of *B. cepacia* and obtained 3 score of points, 17 laboratories produced completely incorrect answers and obtained zero score of points and the remaining 13 laboratories obtained 0.5-2.5 score of points. The main score of points for identification of *B. cepaciae* in these group laboratories was 0.95 score of points (SD±1.1). Statistically there was a significant difference between governmental and private sector hospital's microbiology laboratories for identification of *B. cepacia*. Performance of susceptibility testing for *S. epidermidis* in both groups of microbiology laboratories was satisfactory. The mean score of points for susceptibility testing of *S. epidermidis* in governmental related hospitals microbiology laboratories was 4.8 score of points (SD±0.38) while microbiology hospital laboratories in private sector obtained 4.6 (SD±0.74) score of point for susceptibility testing of *S. epidermidis*. There was not significantly differences between two groups of laboratories for susceptibility testing of *S. epidermidis*. (t-test, p-value = 0.571).

## DISCUSSION

The main goal of EQAS is to improve the quality and strengthen the capabilities of laboratories. In evaluating the microbiology laboratories in Tehran and surrounding districts, it was presumed beforehand that the laboratories were functioning within an acceptable range. Unfortunately present results did not confirm this assumption and there was a wide range of capabilities of the laboratories to identify different species. This failure could have been a result of defective reagents and

differential culture media, inappropriate internal quality control programmes and inadequate numbers of qualified technicians. In a previous study by Abbassi *et al.* (2006), They evaluated the results of 10th external quality assessment results which carried out in reference laboratory of Iran in summer of 2002 which, we distributed five species bacteria (each laboratories two unknown organism) among 487 microbiology laboratories in Tehran and districts. Of 487 laboratories we received answers from 437 (89.7%) laboratories. Of 291 laboratories 224 (77%) produced correct answer for *S. saprophyticus*. Of 146 laboratories 102 (69.85) for *C. freundii*, of 114 laboratories, 34(30%) for *Acinetobacter baumannii* of 146 laboratories 37(25.3%) for *E. faecalis* and of 177 laboratories 63(35.6%) for *E. agglomerance*. There are many studies for evaluation external quality assessment in microbiology laboratories worldwide. For example. The first external quality assessment of clinical microbiology laboratories in Norway in 1982 included 15 country and regional laboratories. The mean number of incorrect identifications was 2.7 (11.3%). Eleven strains were correctly identified by all laboratories, whereas 4 strains were misidentified by 4 to 7 laboratories, accounting for approximately 50% of all misidentifications (Lassen and Sandven (1983). According to Richardson *et al.* (1996) in Canada, the number of participating microbiology laboratories in EQAS declined from 335 laboratories in 1974 to 190 laboratories in 1994. In the initial evaluation, 21% of laboratories did not have the expected capabilities. In 1989, 50% of laboratories achieved high points (above 80%) for isolating and identifying the microorganisms. However, 25% of laboratories scored less than 50% for bacterial sensitivity testing and only 10% of them had high scores (above 80%). This lack of effectiveness was related to inappropriate selection of chemicals.

In another study (Tenover *et al.*, 2001) to evaluate bacterial resistance, the Centres for Disease Control and Prevention (CDC) and WHO distributed 6 different strains of bacteria among 130 laboratories in the United States and other countries. Most of the laboratories were able to identify *S. aureus*, *Enterobacter faecalis* and *Klebsiella pneumoniae* against methicillin, vancomycin and cephalosporin, respectively. However, the rest, especially those that used the disk diffusion method for evaluating the sensitivity of *S. pneumoniae* against penicillin, had

problems. In addition, the majority of laboratories had problems evaluating reduced sensitivity of *S. epidermidis* to vancomycin. Other study by Engler *et al.* (2000) showed only 3 of 23 reference laboratories were able to identify correctly 6 lyophilized *Corynebacterium diphtheriae* strains and to detect the *C. diphtheriae* toxigenicity. A study by Kumasaka (1998) in Tokyo revealed that poor performance in the EQAS survey was closely related to poor laboratory management, the type of training, experience of the medical technicians and the supervisory ability of the consultant physicians in independent laboratories. In a study in the United Kingdom, Pitt and Sands (2002) concluded that the psychological concepts of job satisfaction and climate are factors that might affect external and internal quality control. Lu *et al.* (2004) demonstrated that clinical microbiology laboratories are proficient in detecting high-level but not low level vancomycin resistant enterococci. In a study by Matynia *et al.* (2005) as a part of polish external quality assurance scheme, clinical laboratories were asked to five consecutive isolates of *S. aureus* and the corresponding susceptibility tests to the national centre of quality control in microbiology. Of 1376 isolates submitted as *S. aureus* from 276 medical center, 13 (<1%) had been misidentified by local laboratories. Of 181 (13.5%) MRSA isolates, most were identified correctly (98% of laboratories).

The results of this study reveals that private sector hospitals microbiology laboratories in present county in comparison to governmental hospital microbiology laboratories have poor competency for identification of microorganisms such as *B. cepacia*. *B. cepacia* (formerly *Pseudomonas cepacia*) has been isolated from a wide variety of water and environmental sources in hospitals from which it can be transmitted to patients. This organism causes life-threatening infections in patients with cystic fibrosis or chronic granulomatous disease. In addition *B. cepacia* causes other infections such as urinary tract, respiratory tract, blood stream infections and other sterile body sites (Brooks *et al.*, 2004). *B. cepacia* is a non-fermentative gram negative rods. Differentiating of *B. cepacia* from other pseudomonads including *Stenotrophomonas maltophilia* requires a battery of biochemical tests and can be difficult (Isenberg, 2004; Mahon and Manuselis, 2000). There are multiple factors that may affected the identification and susceptibility tests and standardized methods are more likely to be reproducible than unstandardized methods. Quality assurance is the overall process by which the quality results can be guaranteed. A major part of this process is the internal quality control testing which is routinely undertaken to monitor the precision and accuracy of the

test procedures, the performance of reagents and the performance of the person carry out the tests. However, there are additional aspects that contribute to quality assurance, including regular participation in external quality assessment schemes, internal quality assessment and the validation process, in which atypical or contradictory results can be detected. Education is an important part of the quality assurance process as an understanding of the techniques, together with their limitations and pitfalls, contributes significantly to the recognition, resolution and avoidance of errors (Sharp and Elder, 2004; Brown and King, 2001). Unfortunately many of laboratories in present county do not have material and reagents for performance these tests and internal quality controls are very poor. Many laboratories were restricted so that they no longer had medical technologist or pathologist and/or medical microbiologist dedicated to the performance of microbiology testing. For this reason the majority of laboratories have problems for identification unusual microorganisms.

## CONCLUSIONS

Present study showed that many laboratories especially in microbiology laboratories located in private sector hospitals unable to detect microorganisms such as *Burkholderia cepacia*. We are planning to establish a proper policy for manufacturers (or importers) to produce the necessary and important media and reagents. In addition, adding special postgraduate training courses and distribution of scientific guidelines will be helpful. With these new policies, we hope in future to upgrade the capabilities of the microbiology laboratories in Tehran and districts.

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