Quality Assessment Program for Blood Smear Examination of Health Laboratories in Thailand

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Objective: *Evaluate laboratory performance on blood smear examination among public and private health laboratories.*
Material and Method: *External Quality Assessment Scheme (EQAS) for blood smear examination was organized by the Department of Medical Sciences. The scheme was run in 2005 by sending out six blood smears with normal and various abnormal types of blood cells. Participants were from 731 public and 181 private hospitals with hematology laboratories throughout Thailand.*
Results: *Analysis showed good performance on identification and differentiation of leukemic blast cells and atypical lymphocytes. In addition, good performance was found in platelets reports. However, unsatisfactory performance was found on identification of red blood cells morphology.*
Conclusion: *The present study suggested that the error reported of red blood cell morphology should be further investigated and the problems for improving laboratories performance solved.*

Keywords: *External quality assessment scheme, Health laboratory, Blood smear*

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Microscopic examination of blood smear (or blood film) includes red blood cell (RBC) morphology, identification and differentiation of normal and abnormal white blood cells (WBC) as well as estimation of the amount of platelets (PLT)[1]. The examination of blood smear is an essential tool for diagnosis and management of various hematological diseases and disorders or diseases related to the blood circulation system[2,3]. Accurate and reliable results are, therefore, important for physicians on care and treatment decision.

External quality assessment scheme (EQAS), previously known as proficiency testing (PT) scheme, is the assessment of laboratory quality in a schematic way through an external agency by using material of known value but undisclosed results[4-6]. This assessment measures the accuracy of the results.

To develop a laboratory quality system, the Bureau of Laboratory Quality Standards, Department of Medical Sciences, Ministry of Public Health has organized external quality assessment scheme in hematology (EQAS-H). The scheme has followe the regulation of international organization for standardization and electrotechnical commission (ISO/IEC Guide 43-1): proficiency testing by interlaboratory comparison, development, and operation of proficiency testing scheme and has been fully accredited by National Association of Testing Authorities, Australia (NATA) incompliance with international laboratory accreditation cooperation, G-13 (ILAC-G: 13)[7-9]. The present study was to evaluate the laboratory performance on blood smear examination among public and private health laboratories throughout Thailand in the year 2005.

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Material and Method

Preparation of quality assurance (QA) specimens

The specimens for EQAS-H were obtained from ethylenediamine tetracetate (EDTA) blood of normal individuals as well as patients with various abnormalities of RBC, WBC and PLT. Slides of blood smears were stained by Wright's stain. The quality of staining and cell distributions for each batch was checked under a light microscope. There were three trials per year. Each trial had two blood smears for investigation.

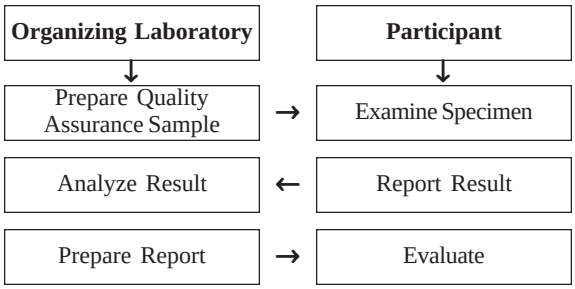

Fig. 1 Steps in EQAS[6]

Scheme design

EQAS-H process followed general steps in EQAS as shown in Fig. 1[6]. Briefly, the EQAS-H organizer distributed the QA samples to its participating laboratories via regular mail. An instruction document was accompanied with the specimens regarding analysis. Laboratories carried out testing of the specimens as other routine samples. Due date and a mailing address were included in the instruction for the participants to return their results. Statistical analysis was used to assess performance of each participating laboratory for individual and collective determinations. The participating laboratories received reports of their performance with recomendations from the organizer.

Performance assessment

Assigned values for each QA specimen were derived from a consensus agreement among experts in hematology at 25 reference laboratories. They were hematological section of Rajavithi Hospital, Siriraj Hospital, Chulalongkorn Hospital, faculty of medical technology Mahidol University, faculty of medical technology Khon Kaen University, faculty of medical technology Chiang Mai University, and some regional hospitals.

Results from each reference laboratories were calculated for mean and standard deviation (SD). Outliers were the values with SD greater or less than 3. Recalculation for mean and SD was done after exclusion of the outliers. The values for each QA batch were assigned and used to assess performance of the participating laboratories. Satisfactory laboratory performance was considered as the values that were within mean $\pm$ 2 SD of the assigned ones.

Results

To evaluate performance on blood smear examination of each laboratory, the author prepared QA samples at a frequency of three times within a year. Six samples were prepared and divided into three trials.

Each trial consisted of two samples. Details of specimens in EQAS-H are shown in Table 1. Nine hundred and twelve hospitals voluntary participated in the scheme. Of 912 participants, 731 were public hospitals at regional, provincial and community levels and 181 were private ones from every region of Thailand. The percentages of reports that the organizer received from trial 1, 2 and 3 were 93.31%, 90.02%, and 88.59%, respectively (Table 2).

There was no difference in the percentages of returning the reports between public and private hospitals at any trials of the scheme.

Identification and differentiation of WBC, RBC, and estimation of PLT were major parameters for the assessment of laboratory performance on blood

Table 1. List of blood smears in EQAS

Trial number [a]	Blood smear	Dominant cell parameter
1	Essential thrombocytosis Normal	marked decrease in platelets normal types and numbers of blood cells
2	Homozygous hemoglobin E (E/E) Acute monoblastic leukemia (M5) [b] [AMoL(M5)]	numerous target RBC monoblasts
3	Acute lymphoblastic leukemia (L1) [b] [ALL(L1)] Acute hemorrhagic fever (AHF)	lymphoblasts atypical lymphocytes and marked decrease in platelets

[a] Two samples for each trial

[b] French-American-British group classification

Table 2. Numbers of dispatched QA specimens and returned reports of the year 2005 EQAS-H

Participants	Number of hospitals that returned reports		
	Trial 1, n (%)	Trial 2, n (%)	Trial 3 n (%)
Public hospitals (n = 731)	680 (93.02)	658 (90.01)	637 (87.14)
Private hospitals (n = 181)	171 (94.48)	163 (90.06)	171 (94.48)
Total (n = 912)	851 (93.31)	821 (90.02)	808 (88.59)

Each value represents number and percentage (%) of the numbers of reports returned to the organizer to the total number of specimens dispatched to the hospitals of each group

Table 3. Participating health laboratories with satisfactory performance

Blood smear	Number of laboratory	Number of laboratory with accepted results		
		WBC, n (%)	RBC, n (%)	PLT, n (%)
Essential thrombocytosis	Public* (n = 692)	674 (97.39)	360 (52.02)	682 (98.55)
	Private (n = 171)	171 (100.00)	79 (46.20)	170 (99.42)
Normal	Public* (n = 692)	661 (95.52)	559 (80.78)	556 (80.34)
	Private (n = 171)	169 (98.83)	142 (83.04)	148 (86.55)
E/E	Public* (n = 668)	657 (98.35)	236 (35.33)	650 (97.31)
	Private (n = 163)	163 (100.00)	81 (49.69)	156 (95.71)
AMoL(M5)	Public* (n = 668)	630 (94.31)	355 (53.14)	629 (94.16)
	Private (n = 163)	159 (97.55)	99 (60.74)	158 (96.93)
ALL(L1)	Public* (n = 640)	530 (82.81)	146 (22.81)	620 (96.87)
	Private (n = 170)	155 (91.18)	53 (31.18)	167 (98.24)
AHF	Public* (n = 640)	621 (97.03)	442 (69.06)	629 (98.28)
	Private (n = 170)	168 (98.82)	131 (77.06)	169 (99.41)

Each value represents number and percentage (%) of the numbers of participating laboratories with satisfactory performance to the total numbers of the participants of each group

* Some hospitals have more than one laboratories participated in the scheme

smears examination. The numbers of reports with accepted results for each of the blood smears are shown in Table 3 and were calculated as the percentages in proportion to the total reports received (Table 3). The author's findings were that both public and private health laboratories demonstrated good satisfactory performance on WBC and PLT for all types of blood smears, whereas poor performance was observed on RBC for essential thrombocytosis, homozygous hemoglobin E(E/E), acute monoblastic leukemia type M5 (AMoL), and acute lymphoblastic leukemia type L1 (ALL).

Although performance on identification and differentiation of WBC under leukemic conditions were good, it was noted that the participants could better identify acute monoblastic cells than acute lymphoblastic cells on blood smears.

Discussion

EQA or PT is the process for analysis of the identical specimen(s) and comparison of individual results of participating laboratories with the values as assigned by the organizer. The process is periodic and retrospective, and provides the assessment of performance rather than a true control for each test performed on the patient's specimen[5].

Most of the participating laboratories demonstrated poor performance on RBC morphology. It was found that the laboratories reported the erroneous cells, which should not have been on the type of blood smears. The other courses may be due to limited knowledge or examining the smears at uncorrected areas. It is difficult to distinguish the morphology of RBC at the thick end or at the very thin edge of the film[1,10,11]. Therefore, it is important for each technician

to observe red cell morphology only at the optimal area. It is also possible that a status of a microscope, for instance, dirt, uncorrected illumination, and inadequate maintenance will lead to any unsatisfactory performance.

The classification of leukemia should be based on morphology of cells in Romanowsky's stained blood and bone marrow films and certain supplemental cytochemical reaction[12]. The present study illustrated that the participants showed high abilities in identification and differentiation of monoblastic cells as compared to that of lymphoblastic cells. This is because the monoblast is a large-size cell with dominant nuclei, abundant cytoplasm, and Aure's rods, while a lymphoblast is a small-size cell with inconspicuous nuclei, scant cytoplasm, but no Auer's rod[12]. Therefore, identification of the monoblast is easier than that of the lymphoblast. It was also noted that most laboratories made errors on reporting the lymphoblasts as lymphocytes.

There was no difference in the percentages of accepted reports obtained from public and private health laboratories, indicating similarity in potentials of technical personals on identification and differentiation of blood cells.

In conclusion, participation in EQAS-H leads to understanding and knowing competence of each laboratory. Therefore, education and supervision should be continuously provided to laboratory personnal for improvement of their knowledge, skill and quality on blood smear examination. The error of RBC morphologic examination should be discovered and solved for improving laboratories performance.

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References

1. Linne JJ, Ringsrud KM. Basic technique in clinical laboratory science. 3rd ed. St. Louis: Mosby-Year Book; 1992: 225, 246-53.
2. Evatt BL, Gibbs WN, Lewis SM, Mc Arther JR. Anemia: fundamental diagnostic hematology. 2nd ed. Geneva: US Department of Health and Human Services and World Health Organization; 1992: 6-7.
3. Ross DW. Laboratory evaluation of the patient with hematological disease. In: Brick RL, editor. Hematology: clinical and laboratory practice. St. Louis: Mosby-Year Book; 1993: 7-16.
4. World Health Organization. External quality assessment of health laboratory. EURO Reports and Studies 36. Copenhagen: WHO; 1981: 3-4.
5. Sharma KB, Agarwal DS, Arya SC, Bullock DG, Lewis SM, Prakasb K, et al. Health laboratory services in support of primary health care in developing countries. Series No. 24. New Delhi: WHO Regional publication, South East Asia; 1994: 77-9.
6. Kumari S, Bhatia R. Quality assurance in bacteriology and immunology. 2nd ed. Series No. 28. New Delhi: WHO Regional publication, South-East Asia; 2003: 60-2.
7. International Laboratory Accreditation Cooperation. ILAC-G: 13. Guidelines for the requirements for the competence of providers of proficiency testing schemes. Silverwater, Australia: ILAC publication; 2000.
8. Chamroon S. Proficiency testing provider in health laboratory: a fully accredited by NATA in compliance with ISO/IEC Guide 43 and ILAC-G: 13. Bull Dept Med Sci 2007; 49: 9-18.
9. National Association of Testing Authorities (NATA). Facilities and labs. Department of Medical Sciences in Proficiency Testing Scheme Provider [homepage on the Internet]. 2005 [cited 2008 Jan 19]. Available from: http://www.nata.asn.au/index.cfm?objectid
10. Bain BJ. Blood cell morphology in health and disease. In: Lewis SM, Bain JB, Bates I, editors. Dacie & Lewis practical haematology. 9th ed. London: Churchill Livingstone; 2001: 65-70.
11. Elghetany MT, Davey FR. Erythrocyte disorders. In: Henry JB, Davey FR, Herman CJ, McPhearson RA, Pineus MR, Threatte GA, et al, editors. Clinical diagnosis and management by laboratory methods. 12th ed. Philadelphia: WB Saunders; 2001: 542-51.
12. Hutchison RE, Davey FR. Leukocytic disorders. In: Henry JB, Davey FR, Herman CJ, McPhearson RA, Pineus MR, Threatte GA, et al, editors. Clinical diagnosis and management by laboratory method. 12th ed. Philadelphia: WB Saunders; 2001: 597-604.

การประเมินคุณภาพการตรวจสเมียร์เลือดของห้องปฏิบัติการสาธารณสุข

สุนันท์ จำรูญ

การประเมินคุณภาพการตรวจสเมียร์เลือดของห้องปฏิบัติการชั้นสูตรสาธารณสุขได้ดำเนินการในปี พ.ศ. 2548 โดยจัดส่งสเมียร์เลือด จำนวน 6 แผ่น เป็นชนิดเม็ดเลือดปกติและชนิดที่มีความผิดปกติของเม็ดเลือดแดง เม็ดเลือดขาว และเกล็ดเลือดไปยังห้องปฏิบัติการโลหิตวิทยาของโรงพยาบาล สังกัดภาครัฐ จำนวน 731 แห่ง และ โรงพยาบาล สังกัดภาคเอกชน จำนวน 181 แห่งทั่วประเทศ ผลการประเมินคุณภาพการวิเคราะห์เพื่อจำแนกชนิด เซลล์อ่อนของเม็ดเลือดขาว (blast cells) บนสเมียร์เลือดชนิดลิวคีเมีย และการจำแนกชนิด atypical lymphocytes บนสเมียร์เลือด ชนิดไข้เลือดออก พบว่ารายงานถูกต้องได้ผลดี การประมาณจำนวนเกล็ดเลือดได้ผลถูกต้อง อยู่ในเกณฑ์ดีเช่นเดียวกัน อย่างไรก็ตาม ความสามารถการรายงาน ลักษณะของเม็ดเลือดแดงผิดปกติยังมี ประสิทธิผลไม่เป็นที่น่าพอใจ ผลของการศึกษานี้มีข้อคิดเห็นว่า ควรค้นหาสาเหตุความผิดพลาดการรายงาน รูปร่างลักษณะของเม็ดเลือดแดง และหาแนวทางแก้ไขปัญหา เพื่อให้ห้องปฏิบัติการได้มีการพัฒนาและรายงานผล ได้ถูกต้อง