

## Comparative study of direct test-cost between microscopy method and IQ200 automated urine microscopy analyzer

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- Background** : Microscopic examination of urine sediment is an essential part in the evaluation of renal and urinary tract diseases. Manual microscopic technique is imprecise; it has wide inter-observer variability and is time-consuming. Recently, IQ200 automated urine microscopy analyzer seems the answer to the need to improve the accuracy, precision and throughput.
- Objective** : To compare direct test-cost (dTC) between the microscopy method and the IQ200 automated urine microscopy analyzer. They were descriptively and retrospectively studied. Direct test-cost of test and calculated from the major direct cost categories, including labor cost (LC), material cost (MC) and capital cost (CC).
- Results** : We found that the dTC of the microscopy method was lower than the dTC of the IQ200 automated urine microscopy analyzer. Fifty-two percent of the dTC of the microscopy method was the labor cost. On the other hand, 87% of the dTC of IQ200 was material cost.

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**Conclusion** : *From the data, we conclude that selection between the microscopy method and automated microscopy urine analyzer relies on workload, manpower, budget and cost of the test. However, we believe that a combination of the microscopy method and automated microscopy urine analyze is the best way for laboratory management.*

**Keywords** : *Direct test-cost, IQ200 automated urine microscopy analyzer.*

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เพ็ญประภา ใจหวัง, ประภาวดี เอกวงศ์, วิโรจน์ ไวกวนิชกิจ. การศึกษาเปรียบเทียบต้นทุนโดยตรงต่อรายการตรวจตะกอนปัสสาวะโดยกล้องจุลทรรศน์และเครื่องตรวจวิเคราะห์อัตโนมัติ IQ200. จุฬาลงกรณ์เวชสาร 2549 ๕.ค; 50(12): 843 - 50

- ภูมิหลัง** : การตรวจวิเคราะห์ตะกอนปัสสาวะ เป็นส่วนสำคัญในการใช้ประกอบการวินิจฉัย ติดตามความก้าวหน้าของโรคไตและโรคทางเดินปัสสาวะ การตรวจวิเคราะห์โดยใช้กล้องจุลทรรศน์ อาจไม่แม่นยำและมีความแตกต่างกัน ขึ้นอยู่กับความชำนาญประสบการณ์และความรู้ความสามารถของบุคลากร รวมทั้ง ใช้เวลามากในการตรวจวิเคราะห์ ปัจจุบันการใช้เครื่องตรวจวิเคราะห์ตะกอนปัสสาวะอัตโนมัติ IQ200 จะเป็นการช่วยเพิ่มความถูกต้อง ความแม่นยำ รวมทั้งใช้เวลาในการตรวจวิเคราะห์สั้น
- วัตถุประสงค์** : เพื่อการศึกษาเปรียบเทียบต้นทุนโดยตรงต่อ รายการตรวจตะกอนปัสสาวะ โดยกล้องจุลทรรศน์และเครื่อง IQ200 โดยวิธีการศึกษาแบบตรวจสอบข้อมูลย้อนกลับและ พรรณนา ต้นทุนโดยตรงต่อรายการตรวจตะกอนปัสสาวะ คำนวณจาก ค่าจ้างแรงงาน ค่าวัสดุ น้ำยา และค่าลงทุน
- ผลการศึกษา** : คณะผู้วิจัยพบว่าต้นทุนโดยตรงต่อรายการตรวจตะกอนปัสสาวะโดยกล้องจุลทรรศน์ มีต้นทุนต่ำกว่าค่าที่ได้จากเครื่อง IQ200 โดย 52 % ของต้นทุนโดยตรงด้วยกล้องจุลทรรศน์ เป็นค่าแรงงานในขณะที่ 87 % ของต้นทุนโดยตรงด้วย IQ200 เป็นค่าวัสดุ น้ำยา
- สรุป** : จากผลการศึกษาคณะผู้วิจัยสรุปว่า การที่เลือกวิธีการตรวจวิเคราะห์ ตะกอนปัสสาวะว่าจะใช้กล้องจุลทรรศน์ หรือเครื่องตรวจวิเคราะห์อัตโนมัติ ขึ้นอยู่กับปริมาณงาน อัตรากำลัง งบประมาณ และค่าตรวจตะกอนปัสสาวะ อย่างไรก็ตามการใช้ทั้งกล้องจุลทรรศน์และเครื่องตรวจวิเคราะห์อัตโนมัติ จะยังเป็นวิธีการบริหารจัดการห้องปฏิบัติการที่เหมาะสมที่สุด
- คำสำคัญ** : ต้นทุนโดยตรงต่อรายการตรวจ, เครื่องตรวจวิเคราะห์ตะกอนปัสสาวะอัตโนมัติ IQ 200

Microscopic urine sediment analysis is one of the most commonly performed tests found in medical laboratory as it provides essential information for clinicians regarding the presence or absence of urinary tract or renal disease states. Unfortunately, the traditional microscopy examination of urinary sediment lacks precision and it has wide inter-observer variability.<sup>(1-4)</sup> Moreover, it is labor-intensive and time-consuming. Several years ago, image-based analysis systems have been developed to improve the accuracy and increase the speed of the throughput. However, the operator still needs to confirm, delete, or reclassify the images of cells and other formed elements while the sample is processed.<sup>(5-6)</sup> Recently, IQ200 automated urine microscopy analyzer [IQ200; IRIS, Chatsworth, CA]; an automatic particle recognition performance has been introduced

The current economic constrain demands effective management of laboratory. From now on, price-based costing will be the key to survival, and large volume production is a way to reduce the total cost and to achieve this in laboratory.<sup>(7)</sup> So the aim of this study was to compare the direct test-cost between that of the microscopy method and the IQ200 automated urine microscopy analyzer. These data could be useful not only for us but also for other users, who are deciding to use the automated urine microscopy analyzer in stead of the microscopy method.

## Materials and Methods

We designed a descriptive and retrospective survey to determine the direct-cost of the microscopy method and the IQ200 automated urine microscopy analyzer deployed at Department of laboratory

Medicine, King Chulalongkorn Memorial Hospital. A total 31,087 tests that were recorded during office hours (8.00am-4.00pm.) from 1 June to 30 November 2005, were chosen and calculated (Table 1). Data were collected from the following sources: labor cost from the Department of Accounting, material and capital cost from the Department of Supplies, and maintenance cost and statistics of laboratory tests from the Department of Laboratory Medicine. In addition, electric expenses were calculated from power consumption of each instrument.

The IQ200 automated urine microscopy analyzer provided quantitative or qualitative counts of formed elements, such as cells, cast, crystals and organisms. The IQ200 aspirated samples, collected images from samples using digital image capture of particles presented in a flow microscope, and performed image processing to isolate individual particles. Its service rate was 60 samples per hour. It used standard 100 V. to 240 V. -50 Hz to 60 Hz stable power supply.<sup>(8)</sup>

We calculated the direct test-cost of each test from the major direct cost categories including: labor cost (LC), material cost (MC) and capital cost (CC) with using the following formula:

$$\text{direct test-cost (dTC)} = \text{LC} + \text{MC} + \text{CC}^{(9,10)}$$

LC was collected from the amount of salary paid to the staff of the Urinalysis Unit, Department of Laboratory Medicine. Their average labor cost was calculated from the total amount of salaries paid to the staff members divided by the total amount of samples. MC was calculated from the cost of test reagents, slides, cover slips, electricity bills and competency assessment. CC was instrument, maintenance cost and instrument's calibration costs.

The comparison of the direct test-costs between the microscopy method and the IQ200 automated urine microscopy analyzer was also calculated and shown below.

### Results

22,437 routine samples were retrospective and analyzed by microscopy method and 8,650 check up samples by IQ200 automated urine microscopy analyzer (Table 1). LC was estimated by staff of four; three analyzed through microscopy all day, and the other analyzed by microscope in the morning and by the automatic device in the afternoon. We, therefore, estimated by multiplied 3.5 times of the average salary in 6 months plus salary of the staff who prepare sediment in 6 months, that is LC of microscopy method, then multiplied 0.5 times of the average salary in 6 months, that is LC of automatic device. The average LC of microscopy method per sample is 13.58 and the average LC of automatic device per sample is 3.92 (Table 2). The material cost of the microscopy

method was the cost of slides and cover slips, electricity charges (of microscope and centrifuge) and competency assessment cost. The material cost of IQ200 was reagent cost and electricity charges. The average material cost of the microscopy method per sample is 0.88. The average material cost of IQ200 per sample is 26.73 (Table 3). The capital cost of the microscopy method is the cost of 4 microscopies, 2 centrifuges and calibration cost. IQ200 is rented instrument so we did not pay for the instrument maintenance and calibration but they are include in reagent cost. The average capital cost of the microscopy method per sample is 11.74. The average capital cost of IQ200 per sample is 0 (Table 4). The direct test cost of the microscopy method is 26.2 and the direct test cost of IQ200 is 30.65 (Table 5).

Direct test cost = Labor cost + Material cost + Capital cost

$$dTC = LC+MC+CC$$

**Table1.** Total test 31,087 test that had been recorded from 1<sup>st</sup> June to 30<sup>th</sup> November 2005.

Month	Microscopy method	IQ200
June	3,882	2,458
July	3,266	927
August	3,858	4,370
September	3,853	674
October	3,659	1,240
November	3,919	1,981
Total	22,437	8,650

**Table 2.** Labor Cost .

	<b>Microscopy method</b>	<b>IQ200</b>
Total labor cost	304,635	33,945
Average labor cost per sample	13.58	3.92

**Table 3.** Material Cost.

	<b>Microscopy method</b>	<b>IQ200</b>
1. Reagent	-	230,053
2. slide + cover slip	17,950	-
3. Electricity cost		
3.1 Microscopy	302	-
3.2 Centrifuge	919	-
3.3 IQ200	-	1,149
4. Competency assessment	500	-
Total Material Cost	19,671	231,202
Average Material Cost per sample	0.88	26.73

**Table 4.** Depreciation Cost.

	<b>Microscopy method</b>	<b>IQ200</b>
1. Instrument cost		
1.1 microscopy	202,400	-
1.2 centrifuge	60,000	-
1.3 IQ200	-	-
2. Instrument maintenance cost	-	-
3. Instrument's Calibration		
3.1 Microscopy	-	-
3.2 Centrifuge	1,000	-
3.3 IQ200	-	-
Total Capital cost	263,400	0
Average Capital Cost per sample	11.74	0

**Table 5.** Comparative result of direct test cost between the microscopy method and IQ200.

microscopy method				IQ200			
LC	MC	CC	dTC	LC	MC	CC	dTC
13.58	0.88	11.74	26.2	3.92	26.73	-	30.65
51.83 %	3.36 %	44.81 %	100 %	12.79 %	87.21 %		100 %

## Discussion

We studied the direct test-cost which we designed to calculate from direct labor cost, sample material cost and direct instrument and maintenance cost. Since our study was aimed to compare the direct test costs between the microscopy method and IQ200 automated urine microscopy analyzer, we therefore did not calculate the unit cost which was an indirect cost from non-revenue departments and other materials used in the process of test such as urine strips, tubes, urine containers, process labor cost, etc. are included. <sup>(11-14)</sup> The directed cost of the

microscopy method of urinalysis is 26.2 and direct test cost of IQ200 is 30.65. The direct test cost of the microscopy method is little cheaper than that of IQ200. The longer lives of microscope and centrifuge the lower their depreciation, direct cost of microscopy method will be very cheaper than that of IQ200.

The results could be used as basic data for laboratory management and planning not only for our laboratory. We also analyzed the advantages and disadvantage of each condition and demonstrated it in Table 6.

**Table 6.**  
**Microscopy method**

Advantage	Disadvantage
1. Provide all of the detailed information	1. Imprecision
2. Low cost	2. Time-Consuming
	3. Have several process of sediment preparation
	4. Need several staffs

**The IQ200 automate urine microscopy analyzer**

Advantage	Disadvantage
1. Accuracy	1. Cannot provide all of the detailed information obtainable by microscopic examination
2. Rapid turnaround time	2. Sequently cannot replace urine microscopy when making clinical assessment of individual patients
3. Reduce the process of sediment	3. Expensive cost
4. Staff have free time to perform other task within the laboratory	4. If the analyzer break down, staff need analyze by microscope
5. Offer significant labor saving	

From our study, we conclude that the direct test cost of the microscopy method of urinalysis is cheaper, but the technician wasted more time for analysis and took more human personnel. The important point is that we could not repeat the result of the experiment and there is a great deal of difference between productivity of microscopy examination and IQ 200 automated urine microscopy analyzer. If there is a lot of samples, patients must wait for a long time and it may be paid for overtime. So we can choose the method: the automatic device or manual method. The decision relies on workload, manpower, budget and cost of test. Our study would be useful for making decision in laboratory management in the future. In addition, we believe that in the next few years the combination of the microscopy method and the automated urine microscopy analyzer will still be the best way for laboratory management.

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