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Future trend of automation laboratory management in Thailand

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Similar to other countries, our health care system was out of economic control. We were spending a higher percentage of our gross national product for health care than before with no sign of improvement. Entering the twenty-first century the pressure from globalization to standardize medical care quality, to extend medical care to a greater percentage of the population and the need to control costs represent the greatest challenges to health care system reform. The budget for each laboratory service has to be carefully allocated. The most important factor in management is efficiency. From now on, price-based costing will be the key to survival and large volume production is one way to reduce total cost and to achieve this in regional central laboratories. To cope with a large amount of samples and consequent labor problems, the emerging concepts of Laboratory Automation Systems (LAS) and Total Laboratory Automation (TLA) give a vision of how the central laboratory in the future might look. As a consequence, health care providers have increasingly realized the need to complement centralized laboratory facilities with satellite laboratories or a Point-of-Care Testing (POCT) network that provide rapid results. The combination of LAS and POCT is successful in many developed countries and will be the future trend in laboratory management in Thailand.

Objective: The information and idea for automation laboratory management is presented to prepare and plan for what will occur in the future for automation or big laboratory.

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To prepare and plan for what will occur in the future for automation or big laboratory, a plan for automation laboratory management is presented.

Key words: *Lab management, TLA, POCT.*

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เช่นเดียวกับประเทศอื่น ๆ ค่าใช้จ่ายด้านการให้บริการด้านสาธารณสุขของประเทศเราได้กลายเป็นภาระทางเศรษฐกิจที่ยากจะควบคุม ผลผลิตมวลรวมของประเทศถูกนำมาใช้จ่ายในด้านนี้คิดเป็นร้อยละสูงขึ้นทุกที โดยไม่มีแนวโน้มที่แสดงให้เห็นถึงการพัฒนาที่ดีขึ้น เมื่อก้าวเข้าสู่ศตวรรษที่ยี่สิบเอ็ดความกดดันจากความเจริญของสังคมโลกอย่างไร้พรหมแดน ก่อให้เกิดการเรียกร้องให้มีมาตรฐานการบริการที่มีคุณภาพ ประชากรซึ่งก็คือผู้ใช้บริการที่มีจำนวนเพิ่มสูงขึ้นรวมทั้งความจำเป็นที่จะต้องควบคุมงบประมาณค่าใช้จ่าย เหล่านี้ล้วนผลักดันให้เกิดการปฏิรูปการให้บริการด้านสาธารณสุขครั้งสำคัญ งบประมาณสำหรับการบริหารจัดการห้องปฏิบัติการทางการแพทย์ได้รับการจัดสรรอย่างระมัดระวัง ประสิทธิภาพในการบริหารจัดการกลายเป็นเรื่องสำคัญที่สุดที่จะทำให้ห้องปฏิบัติการทางการแพทย์ดำเนินการต่อไปได้ การบริหารจัดการให้มีต้นทุนต่ำลง และเพิ่มปริมาณงานให้สูงขึ้นอย่างมีประสิทธิภาพ ก่อให้เกิดแนวคิดเรื่องการปรับปรุงการทำงานห้องปฏิบัติการทางการแพทย์ที่ให้บริการเฉพาะโรงพยาบาลหนึ่งโรงพยาบาลเดียวสู่ห้องปฏิบัติการกลางทางการแพทย์สำหรับชุมชน และทำให้มีความจำเป็นต้องปรับการทำงานห้องปฏิบัติการในอนาคตไปสู่ระบบอัตโนมัติมากขึ้น จนถึงระบบอัตโนมัติสมบูรณ์แบบ (Total Laboratory Automation, TLA) ขณะเดียวกันความซับซ้อนของระบบดังกล่าวทำให้เกิดความต้องการการบริการของห้องปฏิบัติการย่อย ๆ ขึ้น เพื่อการให้บริการที่รวดเร็ว ณ จุดที่ให้การรักษา (Point-of-Care Testing, POCT) การบริหารจัดการที่ผสมผสานระหว่าง TLA และ POCT ได้รับความสำเร็จในประเทศที่พัฒนาแล้วหลายประเทศ และแนวคิดนี้กำลังมีแนวโน้มที่จะเป็นตัวกำหนดทิศทางในอนาคตของการบริหารจัดการห้องปฏิบัติการทางการแพทย์ในประเทศไทย

บทความนี้จึงถูกนำเสนอเพื่อเป็นส่วนหนึ่งของแนวคิดในการเตรียมการและการวางแผนสำหรับการบริหารจัดการในอนาคต โดยเน้นเฉพาะห้องปฏิบัติการทางการแพทย์ที่มีขนาดใหญ่ซึ่งเป็นห้องปฏิบัติการอัตโนมัติ

Laboratory testing initially began with a microscope and basic facilities for chemical tests. The laboratory service started as a single unit with limited equipment and test repertories. At present, there are a number of specialized services and the main determinant for the laboratory's size and scope varies according to patient population, clinical specialties, and financial considerations. The development of the laboratory has been continuing according to the expanding knowledge of the pathophysiology of diseases and therapeutic strategies. As a result, there are now a vast number of investigative procedures available to the clinicians. Furthermore, there is tremendous sophistication in both the design of each individual procedure and the automation required to handle samples submitted for analysis. The ever-increasing number of tests has caused a dramatic explosion in the volume of diagnostic tests over the past four decades. Automation plays a significant role in helping the laboratory workers to cope with a vast amount of samples. Hence, the emerging concept of laboratory automation systems (LAS) and total laboratory automation (TLA) give a vision of how the central laboratory in the future might looked.[1] However, while automation has made a dramatic improvement in terms of productivity considering the relationships between laboratory personnel, space, and equipment required, it has also demanded an increasing level of sophistication in terms of sample transportation and reporting of results. As a consequence, health care providers have increasingly realized the need to complement the centralized laboratory facilities with a well distributed point-of-care testing (POCT) network that provides the rapid results required in certain situations in population-based medicine (PBM).[2] The conflict between centralization and decentralization contributes to the problems in laboratory management that remain to be solved in the future. Figure 1 and Figure 2 show steps in the traditional blood analysis process for a central laboratory and steps in the POCT blood analysis process, respectively. [3]

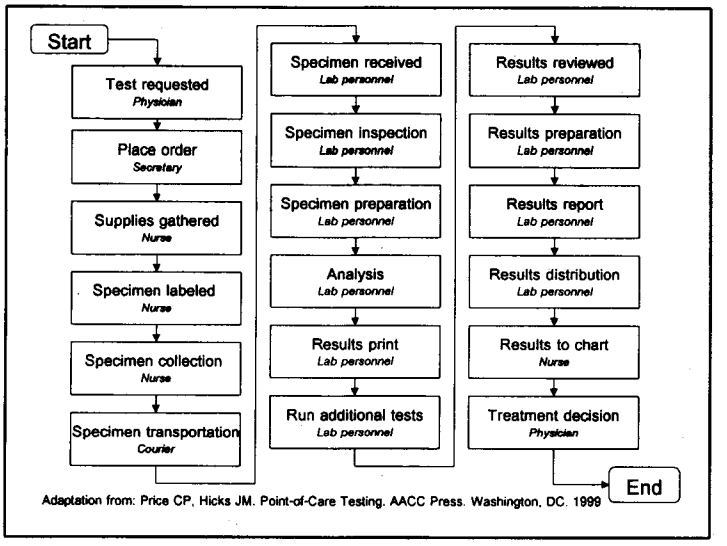

Figure 1. Steps in traditional blood analysis process in central laboratory service.[3]

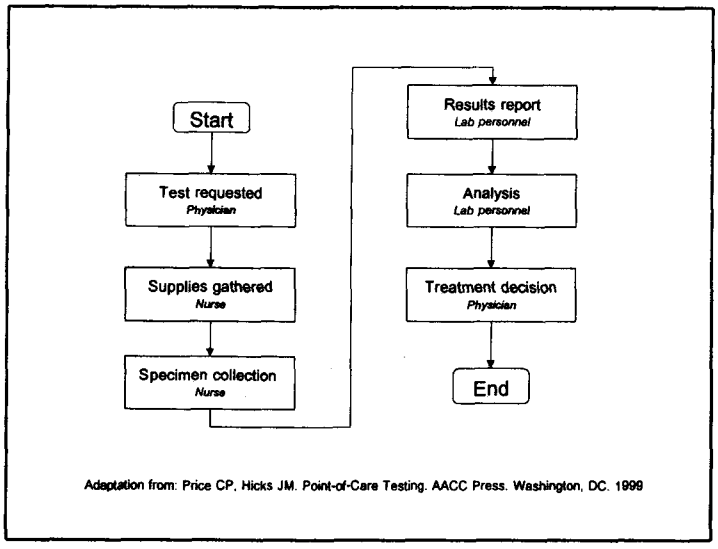

Figure 2. Steps in POCT blood analysis process.[3]

From the point where we are, there is no doubt that any business in the future has to be geared up towards globalization and international trade.[4-5] The competition will be intense. In order to be successful, good management is required in every business, even in a medical laboratory service. Adaptation and improvement of the business at the proper time need to be frequently reviewed and planned ahead, step by step.

Situation of automation laboratory in Thailand

From almost two thousand laboratories in Thailand, most of the laboratory is in the hospital which may divided into three types; university & affiliated, government, and private hospitals. About one third of laboratory is still done manually, meanwhile the most is functioned by combination of manual and semi-automation machines and only not more than ten percentages of the left is big or automation laboratory. However, these big laboratories have been needed to service a large number of patients in big hospitals. Since these automation laboratories consume big amount of budget, so without good management concept they would not be only a non-revenue producing cost center (NRPCC) but a big consumed part instead of a revenue producing cost center (RPCC). There was a report[6] informed that in the university & affiliated laboratories, there were enough instruments to provide for the expansion of laboratory service to two times over the daily work while the expansion could be three and a half and five times in the government and private laboratories, respectively. These data suggested that the laboratory management has been needed to improve automation laboratory efficiency.

How to start?

Every business needs to be analyzed and set whatever goal it wants to achieve. Its strengths, weaknesses, opportunities and threats have to be identified. The company policy has to be clear. Vision and mission need to be established, otherwise wasting

of resources will occur, ending in failure.[7] The role of each of the institutes in Thailand should be identified clearly. Instead of competition, cooperation should be more of a concern. Distinctiveness among institutes is appropriate and should be considered as strength. Strategic planning is very important and must be performed, together with proper management.[8] The keys to a good medical service management are quality, efficiency and morality. Quality means measuring up to the standard and fitting the requirements. Efficiency is the effectiveness of using the input resource to get output at a reasonable cost. This means the laboratory processes should provide good quality results with rapid service at low cost. In laboratory medicine management, the right results from the right investigation on the right specimen from the right patient, available at the right time, interpreted using the right reference data, and produced at the right cost are the objective. Morality is conscientiousness with a sense of responsibility, humanity and generosity. It is intangible but most valuable for our lives. In order to have good management, four factors are considered as the input resources: man, material, machine and money. To achieve the target output, the processing system has to be carefully reviewed.

Success Factors, 4 M

Man

Among all four factors, man is the most important part. "Put the right man to the right job" is the art of management. Having good human management will be half the battle for is worth half of a success. However, it is not easy to get it right, since people are complicated, passionate, inconsistent, imprecise, and difficult to control. There are reports that mistakes in laboratory testing are as followes: pre-analytical 46-68 %, analytical 7-13 %, and post-analytical 18 - 47 %.[9] These data indicate that currently the pre- and post-analytical steps are the most frequent source of incorrect results in the total testing process in the clinical laboratory. Fewer mistakes occur during the analytical step itself. Since the pre and post-analytical errors involve humans, it can be deduced that human error contributes a significant part of laboratory mistakes. As a result, the development of Laboratory Information System (LIS) and Hospital Information System (HIS) has been made to counter human errors. LIS/HIS is designed not only for labor saving but also for improving laboratory turn-around time (TAT).[10-12] However, the ability and necessity to install LIS varies among laboratories. In addition, the high cost of hiring well trained and experienced personnel, coupled with an increasing welfare cost, are factors that influence the shift towards automated systems. In a developing country, the lack of well-trained and experienced personnel is considerable while in a developed country the labor expense is more of concern. Loyalty is the most important character of desirable personnel. The concept of continuous specialty education should be encouraged. This provides medical personnel with up to date knowledge. This experience can be shared among the people of the same occupation, hence promoting cooperation.

Material

Nowadays, commercial reagents are widely available. However, in - house reagent preparation should not be abandoned. Joint ventures with

commercial companies or sharing between institutes should be considered. Furthermore, Thai companies, instead of just being agencies, need to be encouraged to produce their own products. Technology transfer could be a key to the success in the future for Thailand. In terms of the medical supply business, it could generate not only profit for the company but also benefit for the patients. Quality of materials is essential to produce up to standard product. This should be the main policy of company management. Good quality costs, but poor quality might cost more in terms of the company survival. Quality materials need to be carefully selected from reliable sources. Choosing proper materials for each procedure is a classic art of laboratory management.

Machine

Considering the current pace of technology development, the market for laboratory instruments is continuously expanding. There are many different types, prices, and levels of sophistication to choose from. The capacity and characteristics of each laboratory have to be matched with the chosen instruments. At present, there is a tendency to shift from a manual method to more convenient and precise automation technology. The role of a laboratory technologist is changing from a manual technician to a machine operator.[13] In the future, laboratory personnel will be required to have a full knowledge concerning the principles of the various instruments in use. Calibration methods must be one of the routine chores that have to be learnt by heart as well as internal and external quality control techniques. The basic knowledge of medical technologists should be revised to include knowledge of the concept of quality control, instrumentation maintenance, and computer operation.[14]

Money

The budget for each laboratory service has to be carefully allocated. As mentioned earlier, efficiency is the body while quality is the brain and morality is the heart of a successful laboratory management. One example of changing of budget policy to achieve successful laboratory management and organization is installing a Planning-Programming-Budgeting System (PPBS) in Faculty of Medicine, Chulalongkorn University. However, controlling PPBS needs to be practical and convenient for the management. Many concepts in laboratory management from developed countries should be adjusted and applied effectively to suit medical practice in Thailand.

What should be the Future Trend of Management?

Instead of operating many satellite laboratories serving on-site at each of the medical care clinics, centralization using LAS or TLA offers the prospect of enormous improvements on the cost of laboratory operations, convenience, quality and management.[14] At the same time, the reason for decentralization, PBM, and the need to provide emergency services (Short TAT or STAT) are the primary reason for the increasing interest in POCT.[15] So far, neither complete centralization nor decentralization has predominated in various laboratory services. The future direction of the laboratory remains uncertain.

At present, the concept of national health-care standardization is of interest to many hospitals in the form of "Hospital Accreditation" or "HA". This

profoundly affects the medical laboratory.[7] Medical laboratory accreditation has been established in order to achieve national standard of morality, quality, and efficiency in laboratory service.[4] The standards of HA, ISO, and Good Laboratory Practice (GLP) are of interest for almost all hospitals. This is a good sign for the health-care revolution. With optimism, we believe that all laboratories in Thailand will be standardized and all patients will benefit.

Besides the points mentioned above, the current economic crisis in Thailand has created havoc in laboratory cost management . POCT and TLA are two hot issues that we will discuss further.

What are POCT and TLA?

POCT is like a centrifugal force that is driving the tests out of the central laboratory service towards the bedside or examination room while TLA is like a centripetal force that is driving the tests in the opposite direction.[16] Table 1 shows the difference between these two forces.

POCT

POCT is an appropriate term to use for all the tests done outside the central laboratory service. It was established several years ago mainly in intensive care units e.g. instruments for measuring blood gases and electrolytes.[16] The concept of POCT appeals to providers of health care, especially in the management of critically ill patients. It provides a quick result and on-time diagnostic information concerning the status of the patient that potentially leads to quicker therapeutic intervention and better outcomes. Devices for POCT must be easy to use, capable of producing instant results consistent with the critical clinical requirement. The procedure must be simple and require only a few steps. However, the main problem for the implementation of POCT is the lack of standards of connectivity of POCT instruments to LIS/HIS.[17] Why is connectivity an issue? The reasons are connectivity gives the laboratory personnel a tool to monitor and manage tests, to collect data for billing and charging purposes, to conduct utilization studies of the tests, to collect information for clinical outcome studies, and to save time and resources. Within the last decade the technology of connectivity has been rapidly progressing and many user requirements have been served.[10] However, an ideal situation has not yet been achieved by any single connectivity system.

TLA

Laboratory automation is not new since this idea was first implemented in 1959 with the concept of the "continuous flow analyzer". Many laboratories have consolidated services and the "island of automation" or "micro-automation" is now the standard approach in almost all clinical laboratories worldwide.[18] Today, the idea of linking micro-automations for specimen processing and transport between workstations is known as macro-automation or TLA. TLA is believed to reduce human errors, improve TAT with high throughput automation, reduce costs, and generate the best quality control. TLA can cope with a high number of specimens quite easily, starting from the beginning (specimen preparation) step to the last (result-reporting) step. The size of the TLA system depends on the volume of specimens to be processed and the policy of the organization. Although the cost of the initial installation is very high, its cost effectiveness in getting the workload done is attractive

Table 1. Comparison of the characteristics between POCT and TLA.

Characteristics	POCT	TLA
Concept	**Decentralization**	**Centralization**
Place	Bedside	Central Laboratory
Tests	Mainly emergency tests	Complete tests
Support	Few specimens for critical decision making	High volume specimens
Steps	Shorter, fewer steps	Longer, multiple steps
Quality control (QC)	Need support from central laboratory service	Easy for internal QC (IQC) and external QA (EQA)
Equipment	**Simple and easy to use**	**Complicated Automation**
Reagent price per test	High	Low
Throughput	Low	High
Installation budget	Low	High
Laboratory Information system (LIS)	**Manual**	**Automation**
Budget	Higher	Lower
Labor	**Nurse**	**Medical Technologist**
Strong point	Best for a small number of specimens at bedside.	Best for high number of specimens
	Simple and easy method	Best for OPD, IPD, special projects, etc.
	Quick result for on time critical decision making	Best method
	User friendly	Complete tests available for selection
	Best for critical illness service such as; ICU, ER, operating room, etc.	Support for study and research projects
	Cost effectiveness for a small number of tests	High efficiency
		Support for IQC and EQA
		Easy for LIS management
		Cost saving for high number of tests
Weak point	Cannot handle high number of specimens	Complicated process
	Accuracy and precision is good for screening	Complicated instruments
	Limited tests available	High budget for initial installation
	Hard for QC	Cannot support instant result for on time critical decision
	Not easy for LIS management	Need well-trained and experienced personnel

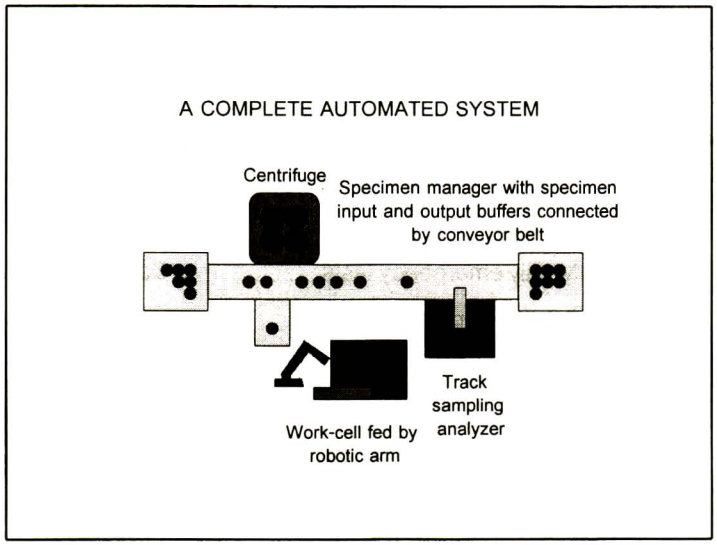

Figure 3. A total laboratory automation system is a custom - design combination of devices that perform all the laboratory process. An input buffer allows specimens to be accumulated in racks as they wait their turns to be transported down the conveyor belt. Specimens that have been analyzed can be collected in the output buffer. Additional peripherals may be added such as a centrifuge, an automation compatible analyzer, or an automated work-cell.[2]

and warrants serious consideration. In general, TLA can be defined as any device, software, or process that improves the efficiency of the laboratory. It is the combination of several instruments, work-cells, integrated work-cells, and integrated modular work-cells coupled with a specimen management and transportation system as well as a process controlling software to automate a large percentage of laboratory work (Figure 3).[2]

Future Trends of Automation Laboratory Management in Thailand

Care providers demand laboratory information in a way that will decrease their decision-making time. They feel the laboratory service is responsible for delivering and managing test information in an efficient way. They thus require a good standard of laboratory information management, not just the laboratory test per se. To fulfill the requirements of the care providers, the laboratory role has to be continuously adjusted to accommodate these expectations. In addition, removing unnecessary steps becomes a core strategy in reducing costs and improving TAT. The elimination of unnecessary complexity and associated hand-off issues also contributes to decrease the potential for errors.

Since there is no perfect system that can serve all the needs of the user, future trends in laboratory service will still have to be a combination of POCT and LAS.[19] This idea has been proved successful for laboratory management by some hospitals. POCT (Figure 4) is efficient and fits well to critical care units such as intensive care unit (ICU), operating room (OR), and emergency room (ER). However, too many satellite laboratories are hard for quality control management and prone to unnecessary

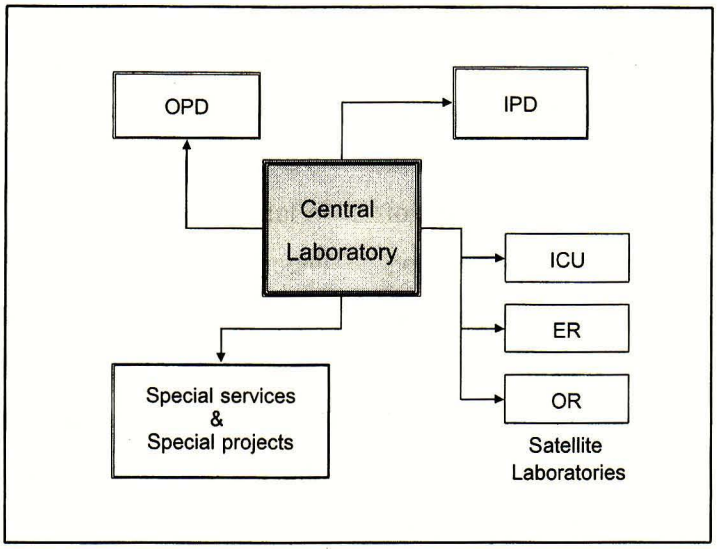

Figure 4. Combination of centralized laboratory and satellite laboratories in one hospital.

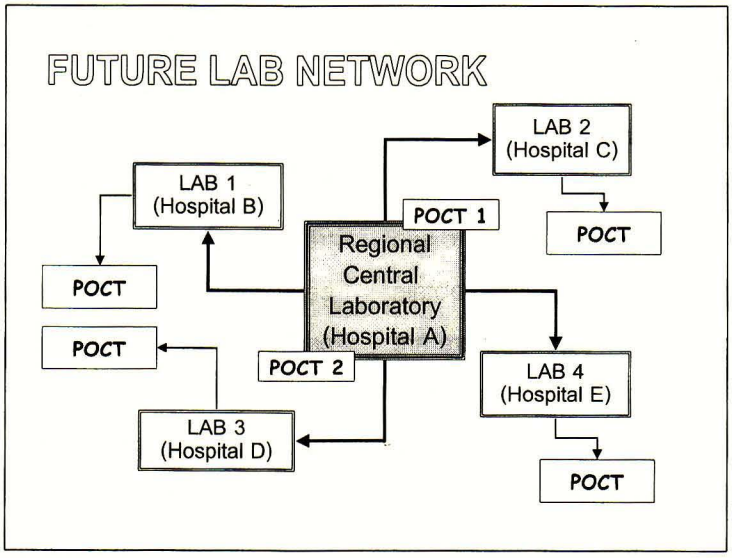

Figure 5. The model of future regional laboratory center. In the future, central laboratory does not only plan for serve one hospital but services to the hospitals and medical care units in the region area as Lab 1,2,3,4 which combines with POCT.

requests. In addition to the efficiency problem, a satellite unit is not fit to serve for a large volume of specimens. Furthermore, the small range of tests provided by POCT are also a limitation. As a result, central laboratory services are still taking the major role to serve all the complicated tests that cannot be provided by small satellite laboratories. TLA is ideal for large volume samples and selected tests requested by the out patient unit (OPD), in patient unit (IPD), outside hospital services, and special projects. However, there are many steps in the processing of specimens that should be reconsidered. Some

unnecessary steps that do not contribute to the diagnostic process should be eliminated to improve TAT and cost effectiveness. To reduce resource requirements and increase output are the aims of achieving a better efficiency. Future trends of laboratory service in Thailand thus include is expanding the laboratory network and especially the regional central laboratories (Figure 5).[20] Medical laboratory management has to be thoroughly revised and planned. Laboratory classification according to capacity and function as manual, semi-automation, and TLA should be considered. Short and long term plans should be prepared.

Deciding whether to implement a new program represents a significant change. A multidisciplinary committee consisting of laboratory staff, nurses, physicians, and administrators should be organized. While change has never been easy, mapping out the system would help those affected by change to see its purpose. This strategic view could help to obtain the maximum positive impact. In addition, there are costs associated with training of doctors and other health professionals on how to use the laboratory, the interpretation of results, quality assurance, auditing, and continual education. These will require the laboratory director or specialist to visit the ward, attend a clinical meeting, etc. Implementation of the new system is not only changing the laboratory process but also changing the role of laboratory personnel.[14]

Opportunity and Pitfalls in the Development of Automation Laboratory in Thailand

There are many factors affecting the development of clinical laboratory service in Thailand that should be pointed out. Firstly, the number of clinical pathologist (CP) is one the smallest of all the medical specialists even though this specialist training has been established in Thailand for more than 20 years. In addition, many physicians stand in the role of CP in laboratory management without recognizing the importance of the specialty. Secondly, there are many separated laboratories scattered all over the place in the majority of large hospitals, especially in the university hospitals. Each laboratory is independent and some tests may be performed by more than one of these satellite laboratories. It is not only the source of patient confusion, but also management inefficiency. Thirdly, the nature of the administration in most hospitals has been centrally organized by doctors who do not have any experience in laboratory management. All these problems are pitfalls for the development of clinical laboratory service in Thailand. This situation has created a vicious cycle for the CP training. Without a whole-heartedly support from the central authority and the recognition of the CP role and responsibility, the number of CP will not be enough to provide for the need of the country. At present, laboratory technicians have been encouraged to manage the laboratory work in most provincial and small to medium sized hospitals. It should be established that the good laboratory management is a direct role and responsibility of CP or appropriate person who work in this field, was trained and had experience in laboratory management. It is not only important for the therapeutic purpose and specialty training but also a sound business sense. Nowadays, seeking financial viability in public health care system is a challenge. All problems should be dealt with properly in order to survive financially, develop properly and to be successful in laboratory management.[13,20,21]

In addition, the SWOT analysis of laboratory service management should be discussed. The strength (S) of the laboratory should be supported continuously while the weakness (W) must be corrected and improved. Using the opportunity (O) for the development meanwhile eradicate all the threat (T).[13,20] The combination of LAS, satellite laboratories and point-of-care testing (POCT) should be studied. With a proper set up of the network and cooperation between hospitals, the satellite laboratories in the satellite hospitals sharing the effective LAS could be the alternative choice instead of full laboratory investment for each hospital.

Conclusions

In conclusion, laboratory management depends on care providers (physicians, nurses, and other medical personnel), government which makes the a country policy and controls the annual budget, hospital administrators who make decisions for the direction of the organization, and patients who are affected directly by medical care services. Another fact is the new technology that has dramatically changed laboratory work enabling the management to consolidate workstations. For instance, immunology testing has essentially become a routine test for many chemistry laboratories. In other words, technology has not only had an impact on chemistry and hematology, but also has had a significant effect in such fields as immunology, microbiology and blood banking as well. With advancing technology, the walls of clinical laboratory divisions are breaking to create a diagnostic service department that is highly efficient and cost effective. Finally, no matter what direction our laboratory service is moving, skillful clinical laboratory scientists will still be a significant force in all health care organizations. Continual education and training will benefit any laboratory personnel in and maintain the professional expertise.

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กิจกรรมการศึกษาต่อเนื่องสำหรับแพทย์

ท่านสามารถได้รับการรับรองอย่างเป็นทางการสำหรับกิจกรรมการศึกษาต่อเนื่องสำหรับแพทย์ กลุ่มที่ 3 ประเภทที่ 23 (ศึกษาด้วยตนเอง) โดยศูนย์การศึกษาต่อเนื่องของแพทย์ จุฬาลงกรณ์มหาวิทยาลัย ตามเกณฑ์ของศูนย์การศึกษาต่อเนื่องของแพทย์แห่งแพทยสภา (ศนพ.) จากการอ่านบทความเรื่อง **"ทิศทางในอนาคตของการบริหารจัดการของห้องปฏิบัติการทางการแพทย์อัตโนมัติในประเทศไทย"** โดยตอบคำถามข้างล่างนี้ พร้อมกับส่งคำตอบที่ท่านคิดว่าถูกต้องโดยใช้แบบฟอร์มคำตอบท้ายคำถาม แล้วใส่ซองพร้อมซองเปล่า (ไม่ต้องติดแสตมป์) จ่าหน้าซองถึงตัวท่าน ส่งถึง

ศ. นพ. สุทธิพร จิตต์มิตรภาพ
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และประธานคณะกรรมการการศึกษาต่อเนื่อง
คณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย
หน่วยจุฬาลงกรณ์เวชสาร
ตึกอบรมวิชาการ ชั้นล่าง
เขตปทุมวัน กทม. 10330

จุฬาลงกรณ์เวชสารขอสงวนสิทธิ์ที่จะส่งเฉลยคำตอบพร้อมหนังสือรับรองกิจกรรมการศึกษาต่อเนื่องอย่างเป็นทางการ ดังกล่าวแล้วข้างต้นสำหรับท่านที่เป็นสมาชิกจุฬาลงกรณ์เวชสารเท่านั้น สำหรับท่านที่ยังไม่เป็นสมาชิกแต่ถ้าท่านสมัครเข้าเป็นสมาชิกจุฬาลงกรณ์เวชสารสำหรับวารสารปี 2545 (เพียง 200 บาทต่อปี) ทางจุฬาลงกรณ์เวชสารยินดีดำเนินการส่งเฉลยคำตอบจากการอ่านบทความให้ตั้งแต่ฉบับเดือนมกราคม 2545 จนถึงฉบับเดือนธันวาคม 2545 โดยสามารถส่งคำตอบได้ไม่เกินเดือนมีนาคม 2546 และจะส่งหนังสือรับรองชนิดสรุปเป็นรายปีว่าท่านสมาชิกได้เข้าร่วมกิจกรรมการศึกษาต่อเนื่องที่จัดโดยจุฬาลงกรณ์เวชสาร จำนวนกี่เครดิตในปีที่ผ่านมา โดยจะส่งให้ในเดือนเมษายน 2546

คำถาม - คำตอบ

1. ปัจจัยที่สำคัญที่สุด ใน 4 M คือข้อใด
   - ก. Man
   - ข. Material
   - ค. Machine
   - ง. Money
   - จ. ทุกข้อมีความสำคัญเท่ากันหมด

✂.....

คำตอบ สำหรับบทความเรื่อง **"ทิศทางในอนาคตของการบริหารจัดการของห้องปฏิบัติการทางการแพทย์อัตโนมัติในประเทศไทย "** จุฬาลงกรณ์เวชสาร ปีที่ 46 ฉบับที่ 4 เดือนเมษายน พ.ศ. 2545
รหัสสื่อการศึกษาต่อเนื่อง 3-15-201-2000/0204-(1008)

ชื่อ - นามสกุลผู้ขอ CME credit ..... เลขที่ใบประกอบวิชาชีพเวชกรรม.....
ที่อยู่.....

1. (ก) (ข) (ค) (ง) (จ)
2. (ก) (ข) (ค) (ง) (จ)
3. (ก) (ข) (ค) (ง) (จ)
4. (ก) (ข) (ค) (ง) (จ)
5. (ก) (ข) (ค) (ง) (จ)

2. เกี่ยวกับ TLA ข้อใดถูกต้องที่สุด
    ก. เหมาะสำหรับการให้บริการแก่ผู้ป่วยในหน่วยวิกฤต
    ข. เหมาะแก่การให้บริการที่มีสิ่งส่งตรวจหรืองานตรวจจำนวนมาก
    ค. ขั้นตอนง่ายไม่ซับซ้อน
    ง. ค่าใช้จ่ายต่อรายการตรวจสูง
    จ. มี low throughput
3. ความผิดพลาดในการให้บริการห้องปฏิบัติการทางการแพทย์เกิดขึ้นมากที่สุดในขั้นตอนใด
    ก. Pre-analytical process
    ข. Analytical process
    ค. Post-analytical process
    ง. Quality control process
    จ. ไม่มีข้อใดถูก
4. อุปสรรคสำคัญในการพัฒนาห้องปฏิบัติการทางการแพทย์อัตโนมัติหรือที่มีขนาดใหญ่ในประเทศไทย คือ
    ก. ขาดแคลนบุคลากรที่จะทำหน้าที่ในการบริหารจัดการห้องปฏิบัติการทางการแพทย์
    ข. การมีห้องปฏิบัติการทางการแพทย์จำนวนมากและกระจัดกระจายอยู่ในโรงพยาบาลขนาดใหญ่โดยไม่ประสานกัน
    ค. ผู้บริหารระดับสูงขาดประสบการณ์และไม่เข้าใจมาตรฐานและวิธีการทำงานของห้องปฏิบัติการทางการแพทย์
    ง. ถูกทุกข้อ
    จ. ผิดทุกข้อ
5. แนวโน้มในอนาคตในการให้บริการทางห้องปฏิบัติการทางการแพทย์อัตโนมัติหรือที่มีขนาดใหญ่ในประเทศไทย คือ
    ก. พัฒนาไปสู่ระบบที่มีการผสมผสานกันระหว่าง TLA และ POCT
    ข. พัฒนาไปสู่การสร้างเครือข่ายการทำงานในโรงพยาบาลเดียวกัน
    ค. พัฒนาไปสู่การสร้างระบบเครือข่ายการทำงานในต่างโรงพยาบาลกัน
    ง. ถูกทุกข้อ
    จ. ผิดทุกข้อ

ท่านที่ประสงค์จะได้รับเครดิตการศึกษาต่อเนื่อง (CME credit)
กรุณาส่งคำตอบพร้อมรายละเอียดของท่านตามแบบฟอร์มด้านหน้า

ศาสตราจารย์นายแพทย์สุทธิพร จิตต์มิตรภาพ
ประธานคณะกรรมการการศึกษาต่อเนื่อง
คณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย
หน่วยจุฬาลงกรณ์เวชสาร ตึกอบรมวิชาการ ชั้นล่าง
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