CHAPTER II
LITERATURE REVIEW

This chapter consists of 2 major parts. The first part includes the guidelines and training programs of pharmacy technicians in Thailand and other countries. The other reviews the research and articles on the roles, descriptions, and utilization of pharmacy technicians.

Pharmacy Technician Training Guidelines and Programs

1. In Thailand.

1.1 Background (Sakolchai, et al., 1991; Office of the Permanent Secretary, Ministry of Public Health, 1995)

In 1975, the Department of Medical Services, Ministry of Public Health was the only institution developing a pharmacy assistant training course. A junior high school graduate could enroll the training course at the Pharmacy Assistant School, Rajavithi General Hospital, Department of Medical Services. After one year of training, they could work as a pharmacy assistant, under the position level 1 in the hospitals under the Ministry of Public Health. But the productivity of only one training institution was not enough to serve the demand for pharmacy supportive personnel by all hospitals under the Ministry of Public Health. Hospitals under other government units except the Ministry of Public Health had to train their own pharmacy supportive personnel, mostly through on the job training.

In 1980, the provincial Hospital division, Ministry of Public Health and the Office of the Civil Service Commission (สำนักงานคณะกรรมการข้าราชการพลเรือน), Office of the Prime Minister (สำนักนายกรัฐมนตรี) developed "Pharmacy Technician training program" (หลักสูตรเจ้าพนักงานเภสัชกรรม). This program required 2 years training for those with senior high school diploma. After graduated they started working as a pharmacy technician, under the position level 2 in the hospitals under the Ministry of Public Health.

In 1981, the program was revised especially in terms of the qualification of participants, the objectives of the program, and the development of new training plan. The new program was named as "Pharmacy Personnel Program" (หลักสูตรเจ้าหน้าที่เภสัชกรรม). The office of the Civil Service Commission, Office of the Prime Minister accredited the program and later changed the name of the program to "Pharmacy Technician training program 1983" (หลักสูตรเจ้าพนักงานเภสัชกรรม พ.ศ. 2526).

In 1984, the Southern Public Health College, Yala province, was the first college that began the training using the "Pharmacy Technician training program 1983".

In 1985, the Northeastern Public Health College, Khonkaen province, was the second college using the "Pharmacy Technician training program 1983."

In 1986, the Department of Medical Services with the training site at Rajavithi General Hospital decided to revise the "Pharmacy Technician training program 1983" to fit their needs and named the new program, "Pharmacy Technician training program 1986." The Department of Medical Services, then, used the new program in place of the one developed in 1975.

In 1987, the Office of the Civil Service Commission, Office of the Prime Minster decided to promote all of the pharmacy assistant position (level 1-3) to the pharmacy technician position (level 2-4).

In 1990, the Public Health College of the central region, Chonburi province, and the Northern Public Health College, Pitsanulok province, began training using the "Pharmacy Technician training program 1986."

In 1991-1992, after the "Pharmacy Technician training program 1986" had been used for 6 years by 4 Public Health Colleges and Rajavithi General Hospital, the Department of Medical Services, it was found that objectives of the program did not serve the practice of pharmacy technicians in hospitals. In addition, to make the program linked with the policy of the Ministry of Public Health and the change in the scope of pharmacy technician responsibilities, the "Task forced on developing job description, curriculum, and learning process for the development of pharmacy technicians" was appointed to revise the "Pharmacy Technician training program 1986". The program was revised and named as "Certificate of Pharmacy Technique Program (revision 1992)" (หลักสูตรประกาศนียบัตรเทคนิคเภสัชกรรม (ฉบับปรับปรุง พ.ศ..2535)). Later, the Institute of Health Manpower Development, Ministry of Public Health had a policy to change the certificate to be a 3-year college degree. Then, the "Certificate of Pharmacy Technique program (revision 1992)", that had never been taught, was revised again and extended to be a 3-year college program under the name "Certificate in Public Health Program (Pharmacy Technique)" but it had never been used.

In 1993-1995, the Health Training Division (กองฝึกอบรม) was reorganized and merged with the Nursing College Division (กองงานวิทยาลัยพยาบาล) and became the Institute of Health Manpower Development (สถาบันพัฒนากำลังคนด้านสาธารณสุข, Office of the Permanent Secretary (สำนักงานปลัดกระทรวงสาธารณสุข), Ministry of Public Health. The curriculum development plan of the Institute of Health Manpower Development was to develop the certificate and baccalaureate training program, so the "Certificate in Public Health Program (Pharmacy Technique)" was revised again to be the 2-year training program under the name "Certificate in Public Health Program (Pharmacy Technique) (revision 1995)" for the Public Health Colleges and Pharmacy Technician School, Rajavithi General Hospital.

1.2 Current Pharmacy Technician Training Program (Office of the Permanent Secretary, Ministry of Public Health, 1995)

The present pharmacy technician training program used by the Ministry of Public Health is "Certificate in Public Health Program (Pharmacy Technique) (revision 1995)" of the Institute of Health Manpower Development, Office of the

Permanent Secretary, Ministry of Public Health. Students graduated from this program will receive "Certificate in Public Health (Pharmacy Technique) [Cert. P.H. (Pharmacy Technique)]." The philosophy of this program is the foundation of the practice in pharmacy aiming at having knowledge, abilities, skills, attitudes, and educational advance of practice as pharmacy technicians related to the National Public Health Development (การพัฒนาสาธารณสุขของชาติ). The general objective of this program is for the graduates to have ethics, knowledge, ability, initiation, and responsibility to effectively practice as pharmacy technicians. The specific objectives of this program aim for the graduates to

- effectively use primary knowledge in pharmacy to assist pharmacists for pharmacy practice,
- effectively cooperate with health team and other organizations,
- work together with health team effectively with positive attitude,
- use basic knowledge for further education.

This program has been used since the academic year 1995 and taught by instructors from health and other related organizations or institutions (under or not under the Ministry of Public Health). The target numbers of students produced by this program in 6 Sirindhorn Public Health Colleges (วิทยาลัยสาธารณสุขสิรินทร) under the Institute of Health Manpower Development, Ministry of Public Health (Prabaromrajchanok Institute) are as shown in Table 2.1.

Table 2.1. The target numbers of students for the "Certificate in Public Health Program (Pharmacy Technique) (revision 1995)" by the Institute of Health Manpower Development.

Program	Institutes (Sirindhorn Public Health College)	target number of students (persons)			total (persons)
		1995	1996	1997	
Certificate in Public Health Program (Pharmacy Technique)	Chonburi	50	50	50	150
	Khonkaen	50	50	50	150
	Yala	50	50	50	150
	Pitsanulok	50	50	50	150
	Trang	-	50	50	100
	Ubonrachathani	-	50	50	100
total		200	300	300	800

Admission Requirements: Applicants must

1. be senior high school graduates with the curriculum containing at least 15 credits in sciences according to the curriculum of the Ministry of Education (not for the comparable curriculum).
2. have Thai nationality.

3. be 16-25 years of age (on the date of application).
4. be residence of the specified areas for not less than 1 year
   - at specified provinces or local areas or nearby areas of the applied college
   - if the applicants moved to study at other areas, the evidences of a parent that have stayed at the specified areas not less than 5 years are needed.
5. have no color blindness and no infectious diseases or the diseases that will disturb the studying.
6. have good behavior.
7. have other qualifications according to the Civil Service Act (พระราชบัญญัติระเบียบข้าราชการพลเรือน).

The written examination and interview are the methods used for selection of the applicants. The budget for this program comes from every Sirindhorn Public Health Colleges under the Institute of Health Manpower Development, Office of the Permanent Secretary, Ministry of Public Health. The College operates on a semester system with at least 15 weeks for one semester.

Credit Hour Definition:

1. One credit for course work is equivalent to at least 15 hours of lecture for one semester.
2. One credit for laboratory subject is equivalent to 2-3 hours/week or 30-45 hours of laboratory practice or experimentation time throughout one semester.
3. One credit for professional practice subject is equivalent to 3-6 hours/week or 45-90 hours of professional practice for one semester.

To qualify for graduation, students must complete 85 credits within 8 semesters and not before 4 semesters.

2. <u>In other countries.</u>

2.1. In the United State of America.

Many pharmacy professional organizations recognize that augmenting the use of well-trained pharmacy technicians under the appropriate supervision of pharmacists is the key component of pharmacy's strategy for achieving pharmaceutical care mission. American Association of Pharmacy Technicians, American Pharmaceutical Association [APhA], American Society of Health-System Pharmacists [ASHP], and Pharmacy Technician Educators Council endorse the "Model Curriculum for Pharmacy Technician Training (First Edition)" to be a prototype for training technicians for services in all practice settings and in all geographical locations. The 30 goal statements of the model are as the following:

<u>Major Areas of Job Responsibility</u>

Goal 1: Assist the pharmacist in collecting, organizing, and evaluating information for direct patient care, drug use review, and department management.

Goal 2: Receive and screen prescription/medication orders for completeness.

Goal 3: Prepare medications for distribution
Goal 4: Distribute medications.
Goal 5: Assist the pharmacist in the identification of patients who desire counseling on the use of medications, and equipment, and devices.
Goal 6: Collect payment and/or initiate billing for pharmacy services and goods.
Goal 7: Purchase pharmaceuticals, devices, and supplies according to an established purchasing program.
Goal 8: Control the inventory of medications, equipment, and devices according to an established plan.
Goal 9: Assist the pharmacist in monitoring the practice site and/or service area for compliance with federal, state, and local laws, regulations, and professional standards.
Goal 10: Maintain pharmacy equipment and facilities.
Goal 11: Assist the pharmacist in preparing, storing, and distributing investigational drug products.
Goal 12: Assist the pharmacist in the monitoring of drug therapy.

Foun dation Knowledge and Skills

Goal 13: Take personal responsibility for assisting the pharmacist in improving the pharmaceutical care of patients.
Goal 14: Demonstrate ethical conduct in all activities related to the delivery of pharmacy services.
Goal 15: Maintain an image appropriate for the profession of pharmacy.
Goal 16: Understand the principles for managing change.
Goal 17: Appreciate the need to adapt the delivery of pharmacy services for the culturally diverse.
Goal 18: Appreciate the benefits of active involvement in local, state, and national technician and other pharmacy organizations.
Goal 19: Appreciate the value of obtaining technician certification.
Goal 20: Understand the importance of and resources for staying current with changes in pharmacy practice.
Goal 21: Communicate clearly orally and in writing.
Goal 22: Use computers to perform pharmacy functions.
Goal 23: Efficiently solve problems commonly encountered in one's own work.
Goal 24: Display compassion for patients and their caregivers.
Goal 25: Maintain confidentiality of patient information.
Goal 26: Understand the scope of pharmaceutical care delivery systems.
Goal 27: Efficiently manage one's work whether performed alone or as part of a team.
Goal 28: Establish and maintain effective interpersonal working relationship with other members of the health care team.
Goal 29: Understand the use and side effects of prescription and nonprescription drugs used to treat common disease states.

Goal 30: Assist the pharmacist in assuring the quality of all pharmaceutical services.

(American Society of Health-System Pharmacists, 1996)

2.2. In the Netherlands.

There were two ways to accomplish the knowledge and skills requirement for proper pharmacy technicians in the Netherlands (Van Dalen, 1992). First, about 90% of candidates took a 3-year course from the 29 intermediate service and health colleges (existed since 1984) that had a pharmacy technician department and an examination was taken at the end of the course. The other way, about 10% of candidates acquire the skills in some other way and took the state examination. The subjects taught at the twenty-nine intermediate service and health colleges were as following:

- Dutch: writing letters, reading texts, correct spelling, alphabet, etc.
- Social studies: the background and implications of the profession.
- Relation skills: providing information, communication, attitude.
- Prescription preparation: drug compounding
- Dispensing: packaging, giving written and verbal information, advising patients on the selection of, for example, an over-the-counter product.
- Chemistry: organic and inorganic chemistry and its implications for practicing the profession.
- Physics: physical principles and their relevance to pharmacy.
- Information technology: the role of the computer in the pharmacy and word processing.
- Knowledge of drugs: knowledge of drugs and the principles of pharmacology.
- Pharmaceutical mathematics: calculations needed in preparing and dispensing prescriptions and in the bookkeeping work.
- Health studies: knowledge of the functioning of the human body.
- Accounting: accounts payable, accounts receivable, literature, prescription and stock accounting.

Research and Article on Pharmacy Technician

1. Roles of Pharmacy Technician in Thailand.

Sakolchai, et al. (1991) proposed that job description and responsibilities of pharmacy technicians working in hospitals and provincial public health offices (สำนักงานสาธารณสุขจังหวัด) under the Rural Health Division (กองสาธารณสุขภูมิภาค) ,Office of the Permanent Secretary, Ministry of Public Health were in dispensing service, manufacturing, medical supply administration, public health pharmacy, academic activity, primary health care supportive service, and other designated activities. Based on the academic potential and professional career, the job description, and responsibilities of pharmacy technicians were classified into 2 groups: jobs that

pharmacy technicians could work under pharmacists' consent or supervision and jobs that pharmacy technicians could work independently without pharmacists' audit. The details of jobs description and responsibilities were as following:

1) Dispensing unit.
   1.1) Pharmaceutical product preparation for daily dispensing.
      - Jobs that pharmacy technician could work independently:
         - Keeping pharmaceutical products in specified classes or systems.
         - Pre-packaging, retrieving, and keeping pharmaceutical products.
      - Jobs that pharmacy technicians could work under pharmacists' consent or supervision:
         - Checking pharmaceutical products for dispensing, reporting for degraded or expired pharmaceutical products.
   1.2) Pharmaceutical products inventory management for dispensary or individual patients.
      - Jobs that pharmacy technicians could work independently:
         - Bookkeeping the pharmaceutical supplies by the specified method.
         - Checking for the degraded or expired drug products.
         - Reporting the distributed pharmaceutical products and maintaining the continuous record of pharmacy activities.
      - Jobs that pharmacy technicians could work under pharmacists' consent or supervision:
         - Checking the remaining pharmaceutical products and retrieving them from the main stocks.
   1.3) Prescription dispensing.
      - Jobs that pharmacy technicians could work independently:
         - Calculating drug price / writing the label, auxiliary label, and other documents / counting pharmaceutical products for prescriptions.
         - Reporting the dispensed pharmaceutical products.
         - Distributing specified documents on drug use.
      - Jobs that pharmacy technicians could work under pharmacists' consent or supervision:
         - Dispensing pharmaceutical products to patients in general cases or cases without any complications and educating patients on drug administration methods.
2) Production unit.
   - Jobs that pharmacy technicians could work independently:
      - Keeping and reporting the list of pharmaceutical products that reached the level for production.
      - Sampling water and raw materials for analysis by the specified technique.

- Preparing the container.
- Weighing or measuring volume of drug chemicals and mixing them by the specified technique.
- Sampling substance during the production process and finished products for analysis by the specified technique.
- Keeping and reporting the production statistics.

- Jobs that pharmacy technicians could work under pharmacists' consent or supervision:
  - Preparing the instruments and production area.
  - Inspecting the qualities of raw materials, water, instruments and devices used.
  - Preparing water and containers, water treating and water filter device.
  - Weighing and mixing drug chemicals for the specific cases.
  - Filling finished products into the containers and labeling.

3) Inventory management and purchasing.

- Jobs that pharmacy technicians could work independently:
  - Reporting the list of pharmaceutical products that reached the level for purchasing.
  - Receiving pharmaceutical products from the suppliers, recording and keeping for receiving process.
  - Controlling for cleanliness and arrangement of the stocks.
  - Keeping and reporting related statistics.
- Jobs that pharmacy technicians could work under pharmacists' consent or supervision:
  - Keeping data and reporting the purchasing plan by the specified system including processing the purchasing orders and invoices.
  - Delivering pharmaceutical products to stock keepers and maintaining a record.
  - Reserving pharmaceutical products of the specified classes or systems in main stocks and protecting them from any hazards or losses.
  - Inspecting the stock-in and stock-out documents, bookkeeping and reporting pharmaceutical inventory.

4) Public health pharmacy services included the registration and new drug application process, consumer protection surveillance activities and other jobs.

- Jobs that pharmacy technicians could work independently:
  - Receiving and checking documents and evidences as required for registration and product license applications.
  - Declaring the application results, delivering the permission documents or evidences to the applicants including disseminating the news and the announcements.
  - Collecting the registration fee.

- Preparing the documents and equipment for inspection of the working places, helping pharmacists for the inspection and keeping the inspection information.
- Receiving the complaints from people and organizations including declaring results of consideration or procession.
- Preparing the documents and equipment for product sampling and sending the samples to be analyzed.
- Collecting advertise from the media, sampling the label, leaflet, etc. for inspection.

- Jobs that pharmacy technicians could work under pharmacists' consent or supervision:
  - Receiving and inspecting the requests in the registration and product license applications for registration and approval process.
  - Accompanying with the team for working places inspection and recording results of the inspection.
  - Keeping products that were sampled by pharmacists for sending to be analyzed, following up, receiving, and collecting the results.
  - Inspecting the label, pamphlets, advertise wording and other documents as specified by pharmacists and submitting them for investigation

5) Educational activities of pharmacy departments including drug information service, education, and training.

- Jobs that pharmacy technicians could work independently:
  - Keeping and collecting related textbooks and documents
  - Collecting, assessing, and presenting the drug information service data.
- Jobs that pharmacy technicians could work under pharmacists' consent or supervision:
  - Helping to distribute the knowledge to target groups by the specified method.

6) Primary health care supportive services including the provision of pharmaceutical products to support drug funds, drug funds visiting, disseminating the knowledge about drug and herbal medicine.

- Jobs that pharmacy technician could work independently:
  - Selling the specified pharmaceutical products to drug funds.
  - Reporting and bookkeeping pharmaceutical products transferred to drug funds.
- Jobs that pharmacy technician could work under pharmacists' consent or supervision:
  - Checking up on drug funds' activities.
  - Disseminating knowledge about drug and herbal medicine.

7) Other designated activities.

These jobs description and responsibilities of pharmacy technicians were approved by the Ministry of Public Health on July 10th, 1991.

2. Roles of Pharmacy Technician in Other Countries.

In various countries throughout the world, there are many kinds of pharmacy supportive personnel including secretary, administration officer, clerk, laborer, and pharmacy assistant or pharmacy technician working for pharmacy practice. Duties of clerks and laborers are quite similar but responsibilities of pharmacy assistants or pharmacy technicians are different relying on educational background and licensing requirements in each country. (Lantose, Hemachudha, and Payananthana, 1991)

2.1. Descriptions and Utilization of Pharmacy Technicians

Many previous studies have pointed out that pharmacy technicians, one kind of trained pharmacy supportive personnel working under appropriate supervision and/or control of pharmacists, should be utilized for technical tasks in drug distribution system traditionally performed by pharmacists. Consequently, pharmacists could shift their duties to the clinical role for patient care. (William, 1962; Arhambault, 1970; Lanchner, 1970; Robert, 1974; Zellmer, 1980; ASHP, 1989; AphA, 1990; Jenkins, et al., 1990; Kalman, Witkowski and Ogawa, 1992; Raehl, Pitterle and Bond, 1992; Miller, et al., 1993; Strozynk and Underwood, 1994; Knapp, 1994; Tierney and Brunet, 1994; Guerrero, et al., 1995)

2.1.1. In the United States of America

Various descriptions and utilization of pharmacy technicians were explained, for example:

Archambault (1970) described that "pharmacy technician" was sub-professional personnel (or pharmacy helpers) working in hospital pharmacy under the direct and immediate supervision of pharmacists. With the new trend of using a pharmacy technician, the author proposed that a pharmacy technician would work under the indirect supervision of pharmacists for counting and pouring duties that were restricted by law to licensed pharmacists.

Lachner (1970) described that a "trained pharmacy technician" under the direct supervision and control of pharmacists was used for unit dose dispensing and drug administration system.

Letcher (1973) discussed that a "hospital pharmacy technician" was a person trained to perform specific, manipulative, repetitive tasks involved with the preparation and distribution of medications. Considerations for the specific tasks performed by hospital pharmacy technicians were

1. tasks involved safeguarding the welfare of patients should be done by pharmacists and not be delegated to pharmacy technicians, for example, pharmacy technicians should not be permitted to check other pharmacy technicians performing dispensing functions.
2. tasks required professional should be done by pharmacists and not be delegated to pharmacy technicians.
3. tasks of preparing an intravenous (i.v.) admixture and prepackaging done by a pharmacy technician should be supervised by pharmacists' observing, checking, and maintaining strict adherence.

Robert (1974) reported that hospital pharmacy directors' attitudes were strongly agreed with the utilization of pharmacy technicians in hospital pharmacy practice. Pharmacy technicians were used for basic drug distribution system under the supervision of pharmacists, for example, inventory control, record keeping, prepackaging, stocking, filling floor stock, distributing, and dispensing.

ASHP by Stolar (1981) conducted a mailed-questionnaires survey of estimated 6,100 non-federal hospitals with a full- or part-time pharmacists on the use of pharmacy technicians. The definition of a "pharmacy technician" using in the questionnaire was

> "Someone who, under the supervision of a licensed pharmacists, assists in the 'non-judgmental' aspects of preparing and dispensing medications. Such duties include, but are not limited to: maintaining patient records; setting-up, packaging, and labeling medication doses; filling and dispensing routine orders for stock supplies for patient-care areas; maintaining drug inventories; adding drugs to parenteral fluids; and similar manipulations. The duties of a pharmacy technician do not include those usually performed by secretaries, clerks, typists, delivery personnel, or medication-administration technician"

Of the 83.4% response rate, 75.4±5.8% of hospital pharmacists used pharmacy technicians.

ASHP by Hogan (1985) conducted a mailed-survey of the use of technicians in pharmacy practice in ASHP's 49 affiliated state chapters, which included the district of Columbia and all states except Alaska and Wyoming. The definition of a "pharmacy technician" using in the survey was "nonpharmacists, who, through routine manipulative tasks, assisted in the dispensing and distribution of drugs" (except clerical personnel). Many tasks were permitted to perform by pharmacy technicians in hospitals and community pharmacies as in Table 2.2.

Table 2.2. Functions technicians were permitted to perform[a]

Function	% States[b]
Procurement and Packaging of Drugs	
Inventory	
Checking stock levels	40
Preparing purchase orders	37
Purchasing	35
Unpacking and placing items in storage areas	35
Unit dose packaging and labeling of	
Oral solid dosage forms	40
Oral liquid dosage forms	39
Bulk compounding of medications	31
Bulk reconstitution of injectable medications	36
Extemporaneous compounding of medications	25
Processing Medication Orders	
Receiving a written drug order	30
Receiving a telephone order	6
Filling a new drug order	31
Typing labels for carts	41
Typing labels for prescription containers	40
Physical maintenance of medication profiles	34
Written maintenance of medication profiles	30
Reconstitution of prefabricated oral medications	34
Compounding i.v.admixture and similar products	36
Delivery of medications other than controlled substance to patient-care areas	41
Handling of Oral Requests	
Receipt of oral orders	4
Conversion of oral order to written order	5
Handling of information requests	17
Handling of Controlled Substances	
Delivery of controlled substances to patient-care areas	37
Maintenance of appropriate records for controlled substances	35

[a] = Other functions not listed on the questionnaire were reported by 14% of respondents.
[b] = Based on 41 respondents who answered this question.

ASHP task force on Technical Personnel in Pharmacy (1989) described that "pharmacy supportive personnel" was encompassed all nonpharmacists who worked in a pharmacy and "pharmacy technician" was a category of supportive personnel denoted a skilled worker who had been trained to assist the pharmacist in preparing and dispensing medications.

American Pharmaceutical Association [APhA] (1990) endorsed the term "pharmacy technicians" to describe individuals who assisted pharmacists in performing selected professional duties. They developed a mailed-survey on fitting pharmacy technicians into pharmacy practice, sending to 1,400 APhA members. Of the 61% or 854 respondents, most of them (66.3%) chose the definition of technician as "a category of supportive personnel in pharmacy utilized to perform routine non-judgmental functions under the control of a pharmacist."

Jenkins, et al. (1990) studied in the 340-bed, nonprofit community institution with pharmacy department providing computerized, decentralized unit dose drug distribution. They found that the pharmacy technician-coordinated system for handling floor stock medications saved pharmacists' time and allowed staff pharmacists more time for patient care. The responsibilities of pharmacy technicians in this system were floor stock reviewing weekly for two purposes of refilling the cards and doses to reach par qualities and exchanging the outdated drugs.

Ballington, et al. (1990) surveyed the use of pharmacy technicians in South Carolina by sending 90 surveyed forms to hospital pharmacy directors. Of the 87% usable survey forms returned, the activities of hospital pharmacy technicians were reported as in Table 2.3.

Table 2.3. Reported hospital pharmacy technician activities

Activity	No. (%) Responding Hospitals (n = 78)
Unit dose	67 (86)
Medication cart filling	43 (55)
Medication cart checking	38 (49)
Prepackaging solid doses	62 (79)
Prepackaging liquid doses	54 (69)
Controlled substance dispensing	39 (50)
P.O. special doses	37 (47)
I.V. special doses	31 (40)
Patient profiling	57 (73)
I.V. admixture preparation	52 (67)
Hyperalimentation	25 (32)
Home health - care product preparation	12 (15)
Drug information over the telephone	11 (14)
Quality control	33 (42)
Purchasing	46 (59)
Inventory	58 (74)
Restocking patient - care units	62 (79)
Making rounds to patient - care units	49 (63)
Patient - care unit medication check	37 (47)
Delivering and returning medications	68 (87)
Outpatient medications	30 (38)
Employee medications	35 (45)
Charging or credits	60 (77)
Chemotherapy	7 (9)
Secretarial and related activities	58 (74)
Other[a]	4 (5)

[a] = Patient education, research, unpacking drug orders, restocking shelves, general bookkeeping responsibility, and preparation and delivery of enteral feeding formulas and baby formulas.

ASHP (1991) described the typical pharmacy technician activities in surgery and anesthesiology satellite pharmacy under the supervision of the pharmacist were

- drug distribution: returning unused drugs to stock and charging patients or departments for drug used; checking and replenishing after-hours drug supplies and charging drugs used to appropriate patients or departments.
- controlled-substance management: distributing controlled substances and creating appropriate records; assisting with inventory counts, maintaining perpetual inventory records, disposal of controlled substance with the pharmacist, and participating in audits, assays, and preparation of reports.
- injectable-drug preparation: aseptically compounding, packaging, and labeling injectable drugs and documenting all products made.
- ordering drugs and restocking the satellite: routinely ordering replenishment supplies and delivering in response to the appropriate places.
- orientation and training of new staff: assisting in the orientation and training of new staff (including other technicians).
- quality assurance: regular controlled-substance auditing or assaying; microbiological monitoring of injectable drugs prepared; inspecting of drug supplies.

Holt (1992) reported the drive-up refill service, at a large naval medical facility, that permitted pharmacy technicians to identify the customer by voice box, retrieve requested refills and dispense refills to the customer at the drive-up window. Other tasks performed under the direct supervision of pharmacists (e.g. processing and filling refill requests) were accomplished at the main pharmacy. This service had reduced customer congestion and parking demand and improved customer service at an outpatient pharmacy department.

Blake (1992), a senior pharmacy technician, indicated hospital pharmacy technicians' job functions as: providing basic drug distribution services (such as i.v. preparation and filling of unit dose carts); preparing antineoplastic drugs or epidural narcotic infusions, bulk compounding, inspecting nursing-unit drug supplies. And pharmacists should work as supervisors.

National Association of Boards of Pharmacy [NABP] (1993) defined the term of "pharmacy technician" as

> "the designation of personnel who assist the pharmacist in the practice of pharmacy, who work under the personal and direct supervision of a pharmacist, and who are registered with the state board of pharmacy as defined in the NABP Model State Pharmacy Practice Act and Model Rules"

2.1.2. In the Netherlands

Van Dalen (1992) described "Dutch pharmacy technician" as "someone who can compounding and dispense drugs and who is capable of keeping a community pharmacy running." There were about 9,000 pharmacy technicians worked in the Netherlands and only about 100 of whom were men. They worked in five areas of tasks e.g. extempore preparation of drugs; preparation of stock drugs; preparation and dispensing of special drugs; dispensing drugs and other products; and organization and management. Legally, pharmacists in the Netherlands did not have

to be present in the pharmacy all day and the pharmacy technicians were able to work independently and had their own responsibilities.

2.2. Studies on the Accuracy of Unit Dose Checking by Pharmacy Technicians

2.2.1. In the United State of America

Becher, Johnson, and Longe (1978) studied on the accuracy of pharmacists and pharmacy technicians in checking unit dose carts after the carts were prepared for 92-bed medicine service in a 450-bed teaching hospital. For 10-day study duration, accuracy of the checking by two pharmacy technicians, with high school diplomas and six months' experience, and two pharmacists, with B.S. in pharmacy and residency in ASHP-accredited programs were compared. It was found that error rate of pharmacists' checking (1.86%) was statistically significant higher than error rate of pharmacy technicians' checking (0.87%) ($p = 0.01$).

Woller, et al. (1991) conducted a study on accuracy of pharmacy technician checking unit dose carts prepared by other pharmacy technicians. Twenty seven trained pharmacy technicians, with six months experience in unit dose drug distribution or unit dose cart filling, from 3 hospitals were validated to achieve a 99.8% accuracy rate on 3,500 consecutive doses audited rather than on seven consecutive audits of 500 doses. It was found that accuracy rates of the trained and validated pharmacy technicians were at least 99.94% and remarkably similar. This study was a pilot study of Minnesota Society of Hospital Pharmacists [MSHP] and was planned to be a one-year extended and ten hospitals expanded.

Ness, Sullivan, and Stergachis (1994) conducted a quasi-experimentation pre-evaluation and post-evaluation study to compare the accuracy of technicians and pharmacists in identifying unit dose dispensing errors at three large hospitals (i.e., 160, 229, and 237 beds) in Washington State. The pharmacists dispensing (143,952 unit dose dispensed) and the pharmacy technicians dispensing (151,721 unit dose dispensed) were verified. Rates of dispensing-error identification by pharmacists ($0.0125 \pm 0.0069\%$) and by pharmacy technicians ($0.0119 \pm 0.0001\%$) were not statistically significant different (errors of pharmacists were 107 and of pharmacy technicians were 50).

Spooner and Emerson (1994) evaluated the accuracy (correct drug, correct dose, correct dosage form, correct quantity, and expiration date) of trained technicians checking unit dose carts as compared with pharmacists checking unit dose carts at St. Luke's Regional Medical Center, a 320-bed community hospital. There was no difference between the accuracy of checking unit dose carts by the trained technicians (99.76% accuracy of 7,571 doses checked) and by the pharmacists (98.91% accuracy of 3,116 doses checked).

2.2.2. In Canada

Klammer and Ensom (1994) conducted a study in 591-bed teaching hospital in Vancouver, B.C. to determine if it was reasonable to have pharmacy technicians perform functions of checking of refills of unit dose packaged medications and i.v. admixture refills currently performed by a pharmacists. For the accuracy of checking refills, the error rate committed by pharmacists (1.0%) was statistically significant

higher than that by pharmacy technicians (0.3%) ($p = 0.002$). But for the accuracy of i.v. admixture refills, there was no statistically significant difference (0.1% for both).

From those 5 studies, it may be concluded that well-trained pharmacy technicians, with well-quality controlled of pharmacists, possibly performed the role of unit dose drug dispensing (checking unit dose carts, traditionally performed by pharmacists, prepared by other pharmacy technicians) with sufficient accuracy. It is a good way for pharmacists to have more time spending for more clinical roles without sacrificing the quality of drug distribution functions.