



THE ROLE OF THAI TRADITIONAL MEDICINE IN HEALTH PROMOTION

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The Kingdom of Thailand has its own system of traditional medicine called “Thai traditional medicine” (TTM). It originated during the Sukhothai period (1238-1377) and developed in parallel with the country as a means of national health care until the early 20th century.⁽¹⁾ The spread of modern medicine from the Western world to the East then led to a decline in the practice of traditional medicine in Thailand. As a result, modern medicine eventually replaced TTM and became Thailand’s mainstream health-care system while TTM was neglected for over 60 years until the revival of TTM began in the late 1970s.

This paper will cover the principles of TTM and how they can be applied for health promotion, the movement to revive and integrate TTM into the national health system and the lessons learned.

1. What is Thai traditional medicine?

Legal definitions of Thai traditional medicine

According to the “*Protection and Promotion of Thai Traditional Medicine Wisdom Act B.E. 2542*” (1999), Thai traditional medicine is defined as “the medical processes dealing with the examination, diagnosis, therapy, treatment, or prevention of diseases, or promotion and rehabilitation of the health of humans or animals, midwifery, Thai massage, as well as the preparation, production of Thai traditional medicines and the making of devices and instruments for medical purposes. All of these are based on the knowledge or textbooks that were passed on and developed from generation to generation”.⁽²⁾

Meanwhile, the “*Practice of the Arts of Healing Act B.E. 2542*” defines Thai traditional medicine as “the practice of the art of healing that is based on Thai traditional knowledge or textbooks that have been passed on and developed from generation to generation, or based on the education from academic institutes that the Professional Committee approved”.⁽³⁾

In other words, TTM is regarded as comprising the traditional philosophies, bodies of knowledge and modes of practice to care for the health of Thai people that are congruent with Thai culture and way of life, and based on the principles of Buddhism. TTM uses various forms of practices to complement each other, i.e., medicine, pharmacy, massage, midwifery and maternal and child health care, Buddhist rites and



meditation, as well as other rituals based on the belief in supernatural power or power of the universe. TTM is a holistic and natural approach of health care that is derived from Buddhist beliefs, the observation of and respect for nature, and the wisdom of Thai ancestors.⁽⁴⁾ In addition, traditional knowledge of TTM was also built through the processes of “selection”, “adoption”, “adaptation” and “utilization” of traditional medicine of some countries with which Thailand had contact in the past, e.g., India and China, to suit the Thai way of life.⁽⁵⁾

2. The principles of Thai traditional medicine^(4,6)

The four elements (*tard*) of the body

According to TTM, the human body is composed of four elements (*tard* in the Thai language), i.e., earth, water, wind and fire. When the four elements of the body are in equilibrium, it will be healthy. In contrast, if an imbalance in these elements occurs, i.e., if there is a deficit, an excess, or disability in any of the four elements, a person will become ill. Moreover, the imbalance in the four internal elements and illness can also be due to an imbalance in the four external elements as well.

“*Tard-chao-ruan*” or the dominant element of the body

According to TTM, for each person there will be one element that is more dominant than others, one’s own dominant element is called “*tard-chao-ruan*”, which is basically determined by the date and month of one’s conception. The *tard-chao-ruan* of a person plays an important role with regard to one’s characteristics and appearance as well as the weak point in one’s health.

The causes of illness

According to TTM, human illness can be caused by the following factors:

1. Supernatural power, e.g., ancestor’s soul, powerful spirit of the forest, evil spirits, punishment from a heavenly spirit of those who misbehave.
2. Power of Nature, e.g., imbalance in the four elements of the body, imbalance of heat and cold, and imbalance of the body’s equilibrium.
3. Power of the universe, e.g., positive and negative influences from the sun, the moon and the stars on human health.
4. *Kimijati*, which may be considered the equivalent of microorganisms or parasites in modern medicine.

Moreover, according to TTM, human health is also influenced by:

1. The elements (*tard*). As mentioned previously, an imbalance in the four basic elements of the body and the effect of external elements or the environment can affect human health.



2. The seasons. Heat and cold during different seasons clearly affects human health.
3. Age. Based on TTM, during different periods of life, people are more prone to get ill from the influence of different elements.
4. Geography. As the geographic location of where one life dictates the weather and the environment, it can play a role in affecting one's health.
5. Time. Astrologically, the sun, the moon and the stars continuously move, thereby influencing human life and health differently during different times of the day.
6. Inappropriate behaviours that can be the causes of ailments according to TTM are as follows:
 - 6.1 Inappropriate eating habits, e.g., eating too much or too little, eating food that has gone bad, or unfamiliar food, or food that is not suitable for one's own dominant element or diseases.
 - 6.2 Imbalanced postures while sitting, standing, walking, or sleeping can lead to disequilibrium of the body structure and needless worsening of health.
 - 6.3 Exposure to extreme weather or polluted air.
 - 6.4 Being deprived of food, water or sleep.
 - 6.5 Delayed urination or defecation.
 - 6.6 Overwork, over-exercise, or excessive sexual activity.
 - 6.7 Deep sorrow or extreme exhilaration.
 - 6.8 Extreme anger, lack of equanimity.

Examination and Diagnostic Procedures of TTM

1. Patient's history and chief complaint. In addition to asking about a patient's history, symptoms, chief complaints and usual behaviours or habits, TTM practitioners need to know a patient's date, time, month and year of birth in order to figure out the patient's *tard-chao-ruan* and determine which element is causing the imbalance and illness.
2. Physical examinations, e.g., heart rate, pulse, temperature, visual and manual examination of affected organs or areas of the body, structure of the body, degree of movement of joints and the extremities.
3. Diagnosis. Since each element of the body controls different organs or systems of the body, TTM practitioners can diagnose what is wrong with a patient's *tard* from the patient's symptoms, chief complaint and physical examination.
4. Astrological examination. Some TTM practitioners may also perform astrological examination of patients to determine if their illnesses are the



result of stars, a supernatural power or bad *karma*. If so, a form of rites is usually performed to psychologically boost the patient's morale.

Treatment

TTM is considered a holistic form of medicine. Treatment emphasizes adjusting the balance of the body elements using the health promotion approach. Naturally determined factors, e.g., *tard-chao-ruan*, seasons, external elements and the power of the universe, are also considered in order to give appropriate treatments. Treatments prescribed for patients can be herbal medicine preparations, Thai traditional massage, hot herbal compresses, or herbal steam baths. In addition, the TTM health promotion approach may be used to achieve good health, which is a state of complete physical, mental and social well-being, by correcting the inappropriate, unhealthy behaviours mentioned above and practising *dhammanamai*, which will be described later in more detail.

3. Brief history of Thai traditional medicine^(5,7)

Historical evidence shows that Thai people began to use herbal medicine for health promotion and the treatment of various symptoms and diseases before the Sukhothai period or before 1238 A.D. A stone inscription from King Chaivoraman of the Khmer Kingdom indicated that 102 hospitals called *arogaya sala* were built to serve people throughout that Kingdom, including the northeastern part of today's Thailand.

During the Ayutthaya period (1350-1767), there were a number of pharmacies or drug stores for the public as well as royal dispensary in the royal palace. During the reign of King Narai the Great (1656-1688), the doctors that served the king united to compile a textbook of King Narai's medicines or *Tamra Phra Osod Phra Narai*, which was the first official textbook of Thai drug recipes.

After Burma destroyed Ayutthya in 1767, Thailand's new capital was established briefly in Thonburi and then in Bangkok where the Rattanakosin period began in 1782. Kings Rama I, II and III of the present Chakri Dynasty played an important role in the revival of TTM. Over 1,000 drug recipes and the body of knowledge of TTM regarding the origin of diseases and their treatments were gathered and inscribed on marble tablets and placed on the walls of two temples, namely Wat Po and Wat Raja Oros. The marble tablet inscriptions also included the principle of Thai traditional massage and stretch exercise called *ruesi dud ton* with explanations of the symptoms or diseases each massage spot or exercise posture could heal. The purposes of the Kings' orders were to compile collective knowledge of TTM that was partly lost or destroyed during the war and to give health education to the Thai people so that they could take care of their health using TTM.

During the reign of King Rama V (1868-1910), the first medical textbook *Tumra Paetsart Sonkrau* and the first Thai national formulary called *Tumra Paetsart Sonkhrau Chabub Luang* as well as *Tumra Vejasuksa*, the first TTM textbook for medical students, were published. They are still official textbooks of TTM accepted by the Thai Food and Drug Administration (FDA) for the registration of traditional medicines.



Meanwhile, the influence of Western medicine, which was introduced into Thailand by missionaries and Western physicians starting in the reign of King Rama III, gradually increased. In 1888, Siriraj Hospital, the first Western-style hospital and medical school, was officially opened. Initially, both TTM and modern medical services were provided and the medical school that taught both disciplines of medicine was established in 1889. However, in 1916 the teaching of TTM and the provision of TTM services at Siriraj Hospital were discontinued. The reasons were that the two principles were considered incompatible and confusing to medical students, and because the practice of TTM was viewed as inconsistent and variable depending on a doctor's opinion more than empirical evidence and the teaching curriculum were based on only a few classical textbooks that must be learned by heart only. The abandonment of the systematic teaching of TTM in the medical school sparked the decline in TTM acceptance, especially among well-educated people.

The status of TTM practitioners in the country's health-care system became worse when the "Medical Act B.E. 2466" and the "Control of the Practice of the Art of Healing Act B.E. 2479" were promulgated in 1923 and 1936 respectively. As a consequence of the laws and the misunderstanding on the part of TTM practitioners, the majority of TTM practitioners at that time became unlicensed and could not legally practice since they did not file or obtain a license for their practice. Meanwhile, the licensed TTM practitioners had no role at all to play in the public health service facilities since the health-service system then did not provide TTM services because modern medicine came to replace TTM as mainstream health care. They could therefore only legally practice TTM privately in their own clinics and their role in the provision of health care for the Thai people was therefore limited to only the poor living in rural areas where modern medicines were not easily accessible.⁽⁵⁾

4. The revival of Thai traditional medicine: The role of the government and non-governmental organizations

Sixty-three years after the cessation of TTM services and teaching at Siriraj Hospital, the revival of TTM began around 1978 after the proclamation of the Alma-Ata Declaration. As the World Health Organization (WHO) urged its member countries to include medicinal plants in their primary health care (PHC) programmes, Thailand's Ministry of Public Health responded to WHO's call by including such a policy to promote the use of medicinal plants in PHC since the time of the Fourth Health Development Plan (1977-1981). Government policy regarding the promotion of the use medicinal plants and Thai traditional medicine in the country's health-care system has continued until today as stated in the Fifth to Ninth (current) National Economic and Social Development Plans (2002-2006).^(8,9)

In 1979, a meeting on "Thai traditional medicine" among TTM practitioners, medical doctors and university professors was held at Siriraj Hospital to discuss ways to revive TTM and improve the role of TTM in the health system. In 1986, the Ministry's Division of Health Planning and the Collaborating Centre of Medicine and Health held national seminars on the "Development of Thai Traditional Medicine". However, no clear-cut development plans or projects could be effectively formulated or implemented. One of the conclusions from both seminars was the suggestion to the Ministry to establish an office to play an active role in the revival of TTM.⁽¹⁾



As a result, such an office was established in 1989, initially as the “Collaborating Centre for the Development of Thai Traditional Medicine and Pharmacy” under the Office of the Permanent Secretary. This Centre was later upgraded to division level in 1993 as the “Institute of Thai Traditional Medicine” (ITTM) under the Department of Medical Services.⁽¹⁰⁾ Through the years, the Institute has organized several activities to develop TTM in various aspects. Hence, in October 2002 as a result of the Bureaucratic Reform Act, the “Department for the Development of Thai Traditional and Alternative Medicine” (DTAM) was established as a new department under the Ministry, comprising ITTM, the Division of Alternative Medicine and the Office of the Secretary.^(11,12) This clearly showed the intention and commitment of the government to promote TTM as another means of health care for Thai people.

In addition to the Ministry, non-governmental organizations (NGOs) have also played a role in the revival and development of TTM. In 1980, Professor Dr. Ouay Ketusingh, a renowned senior medical professor of Siriraj Hospital who appreciated the value of TTM for enhancing Thai people’s health and for reducing the cost of health care, made an announcement on the establishment of the “Foundation for the Promotion of Thai Traditional Medicine”, which was officially registered in 1982. The main objectives of the Foundation were to revive TTM knowledge, improve educational standards and the medical practice of TTM and promote TTM education.⁽¹³⁾

One of the major accomplishments of the Foundation was the establishment of a college to teach applied TTM called Ayurvedh Vidhayalai (Jevaka Komarapaj) College in 1982 (*ayurvedh* here literally means “the knowledge of life” not the ayurvedic medicine of India, according to Dr. Ketusingh). In the Foundation’s opinion, though TTM had played an important role in health care for Thai people for over 1,000 years, TTM lacked scientific back-up and a diagnostic system, which relied mainly on a patient’s chief complaints; this could lead to misdiagnosis and treatment failure. Hence, in addition to the study of TTM, pharmacy and massage, the three-year curriculum of applied TTM also includes courses on basic medical sciences, e.g., anatomy, physiology, biochemistry, medical botany, pharmacology, microbiology and pharmacognosy, as well as some basic knowledge of various disciplines of modern medicine. In 1987, the Ministry issued the Control of the Practice of the Art of Healing Act B.E. 2530, allowing the graduates from this college who passed the licensing examination to become licensed applied-TTM practitioners. They are thus legally allowed to use some medical equipment, e.g., stethoscope, sphygmomanometer and thermometer, for physical examination of patients in order to diagnose the patients better in order to determine whether or not modern medical therapy is needed. However, they can prescribe only traditional medicines and use traditional therapies to treat their patients.⁽¹⁴⁾

The Foundation for the Promotion of Thai Traditional Medicine and Ayurvedh Vidhayalai (Jevaka Komarapaj) College also played a significant role in the revival of TTM knowledge in the classical textbook called *Tumra Paetsart Sonkhrau*. Two versions of this textbook were published in 1992 and 1993 respectively; the first one was the “conservative version” or *Tumra Paetsart Sonkhrau Chabub Anurak* entitled *Textbooks of Thai Traditional Medicine* containing the original version of 12 classical textbooks of TTM in the original old-style language⁽¹⁵⁾. The second one was the “developed version” called *Tumra Paetsart Sonkhrau Chabub Pattana*, which elaborated the content of each of the 12 classical textbooks with scientific explanations, using contemporary language for easy understanding by lay people and students.⁽¹⁶⁾



Furthermore, TTM practitioners also played a role in the revival of TTM by forming societies of TTM practitioners at several Buddhist temples. The purposes of these societies are to teach TTM to interested people, treat patients with herbal medicines, Thai massage, hot herbal compresses or herbal steam baths, and disseminate knowledge of TTM to the public by organizing exhibitions and giving lectures.⁽¹⁾

5. Reasons for the government's revival of Thai traditional medicine

The main reasons why the Thai government reconsidered the value of traditional medicine and decided to revive TTM and integrate it into the national health system could be summarized as follows:

1. WHO policy on indigenous medicine and primary health care (PHC). In 1978, WHO/UNICEF issued the Alma-Ata Declaration urging member countries to formulate national policies, strategies and plans of actions to launch and sustain PHC as a part of comprehensive national health systems in order to attain the "Health for All by the Year 2000" target. This included the promotion of the maximum level of community involvement and individual self-reliance and participation and making the fullest use of local, national and other available resources, e.g., medicinal plants, indigenous medicine and appropriate technology.⁽¹⁷⁾

2. The high cost of modern medicine and loss of self-reliance in health care. It was estimated that the inability of modern doctors to assess the cost-effectiveness of their treatments and the non-compliance with the essential drug policy could account for the waste of tens of billions of baht per year. Moreover, most of the health-care budget was spent on diagnosis and treatment rather than on health promotion and disease prevention, which cost less. The reliance on modern medicines even for the relief of common minor symptoms that in the past could easily have been healed with herbal medicines, made the country lose its ability to rely on domestic resources when it came to health care, or its ability to control national spending on health care, as seen from the increase in medical and health expenditures from 15,167.9 million baht in 1978 to 35,973.7 million baht in 1983 and 78,423.1 million baht in 1988.^(9,18)

3. Awareness of the limitations of modern medicine. Even though modern medicine can successfully treat many infectious and serious diseases and increase human life expectancy, it also has some limitations, i.e., serious side effects from certain groups of drugs, the high cost of medications and technology, and the inability to cure several lifestyle-related chronic diseases, e.g., hypertension, diabetes, or cancer. Therefore, traditional medicine might be able to serve as an alternative choice for the people.⁽¹⁹⁾

4. Problems with the quality of the TTM health-care system. Although modern medicine is the mainstream health system, TTM services are still available for people in the rural as well as some urban areas of the country. However, owing to over 60 years of neglect, the overall quality of the TTM health-care system is seriously in need of major improvements to conserve local wisdom about health care and for consumer protection.⁽¹⁸⁾

5. The potential of herbal products and the practice of Thai traditional medicine for the country's economy. After the Dietary Supplement Health and Education Act (DSHEA) took effect in 1994 in the United States, the "health conscious" movement



towards exercise, eating well and the use of dietary supplements for health promotion spread all over the world. This global trend led to the opening up and expansion of the botanical dietary supplement market in the West worth tens of billions of dollars. Hence, the government has fully supported research and development (R&D) of new herbal products by research institutes and the production of herbal products by industry in order to satisfy this global demand. In addition, the global boom in the spa and wellness business during the past 10 years has not only kept high the demand for herbal products, but it has also created new job opportunities for Thai people to learn Thai massage and work as massage therapists at home and abroad. Hence, the training of qualified Thai traditional masseurs/masseuses using the Ministry's curricula are now conducted by many schools in order to meet the demands of the spa business.⁽²⁰⁾

6. The success of China and India concerning the integration of traditional medical knowledge with modern medicine in their national health systems serves as a good example of the benefit that countries and people could gain from traditional medicine. The success of these two countries has helped to boost the confidence of other countries to develop their own traditional medicines and promote their integration into mainstream health system.⁽¹⁹⁾

6. The role of Thai traditional medicine in health promotion

Since the beginning of the revival of TTM in 1978, various aspects and practices of TTM have been promoted for the health promotion of the Thai people and/or integrated into the national health service system,^(6,21) namely:

- Medicinal plants and traditional medicines
- Thai massage or *nuad thai*
- Hot herbal compresses and herbal steam baths
- The Practice of *dhammanamai* which is composed of
 - *Kayanamai* (healthy body), i.e.
 - Eat good food, especially indigenous nutritious fruits and vegetables that are compatible with one's own *tard* or underlying disease, and take traditional medicines or food that can correct the imbalance of *tard* to maintain good health
 - Exercise, e.g., *ruesi-dud-ton*, or Thai traditional stretch exercise
 - *Jitanamai* (healthy mind), i.e., practice of meditation
 - *Chevitnamai* (healthy lifestyle), e.g., live one's life in the "Middle Path" of Buddhism.

How each aspect of TTM has been developed and promoted for the promotion of health of the Thai people and its role in health are summarized as follows.

6.1 The development of herbal medicines and medicinal plants and their role in health promotion

It can be said that medicinal plants are a part of Thai daily life because local Thai foods in different regions of the country consist mainly of several kinds of spices,



vegetables and fruits, some of which can also be regarded as medicinal plants owing to their medicinal value. Hence, Thai people regularly consume various types of medicinal herbs as food and spices.

The promotion of the use of medicinal plants in PHC

The promotion of the use of medicinal plants in PHC was the first movement in the revival of TTM because it was stated in the national policy as a result of the Alma Ata Declaration. Hence, 57 medicinal plants were selected and recommended for the treatment and relief of 19 groups of common minor symptoms and diseases.^(22,23) In addition, some nutritious and healthful fruits, vegetables, cereals and natural food colourants were also recommended.⁽²⁴⁾ The “Medicinal Plants and Primary Health Care Project”, which was a collaborative effort between the Ministry of Public Health, universities and the Ministry of Agriculture and Cooperatives and funded by UNICEF during the period 1983-1985 and GTZ of the German government during the period 1986-1988, was behind the success of this mission. Under this project, UNICEF supported the following :⁽¹⁾

- ❑ The training and dissemination of information on the use and cultivation of selected medicinal plants to health-care personnel and the public;
- ❑ The setting up of information centres on medicinal plants and Thai traditional medicine;
- ❑ The production and distribution of eight traditional household remedies for the medicine and medical supply fund of villages;
- ❑ Funding for 44 research projects on medicinal plants; and
- ❑ The publication of three volumes of the *Medicinal Plants Manual* containing information on 57 medicinal plants and 28 nutritious fruits and vegetables and natural food colourants for health-care workers and the public.⁽²²⁻²⁴⁾

In 1988 the Office of the Committee on Primary Health Care published another book called *Medicinal Plants in Primary Health Care for Healthcare Personnel*, containing information on over 60 medicinal plants, to help promote their use in PHC in communities.⁽²⁵⁾

During the period 1986-1988, with the support of GTZ, the “Medicinal Plants and Primary Health Care Project” focused on complete-cycle research on five medicinal plants: turmeric for dyspepsia, *Andrographis paniculata* for pharyngotonsillitis and *Senna alata* for constipation, conducted by the Department of Medical Sciences; and *Zingiber cassumunar* for muscle pain and sprains conducted by Thailand Institute of Scientific and Technological Research; and *Aloe vera* for burns.⁽¹⁾ Multi-centre controlled trials in humans were conducted on the first three medicinal plants in five hospitals in five provinces. The results of those clinical trials supported their use in PHC and led to the inclusion of herbal medicines from the first four medicinal plants into the National List of Essential Drugs A.D. 1999.⁽²⁶⁾ Furthermore, the results of the studies on the first two herbs were also used as clinical evidence for their selection into WHO monographs on selected medicinal plants.^(27,28)



Besides the Ministry of Public Health, “Medicinal Plants for Self-reliance Project” was one of the NGO projects that also played a role in the promotion of the use of medicinal plants for PHC. The activities of the Project were to educate Thai people about the health benefits of medicinal plants by providing training, issuing tri-monthly journals, publishing books on medicinal plants, and serving as a medium to share experiences among users of medicinal plants.⁽¹⁾

In 1994, based on more recent research evidence, the list of medicinal plants recommended for PHC was revised to include 61 medicinal plants for 21 groups of symptoms and diseases.⁽²⁹⁾ Currently, Thai people also use other herbal products in the form of herbal medicines, herbal drinks, or health foods for health promotion based on TTM principles and new research data.

Herbal medicines in the National List of Essential Drugs and herbal crude drugs in traditional household remedies

While PHC has increased the use of medicinal plants by the public, an attempt has also been made to increase the use of herbal medicines in hospitals in place of modern medicines, where appropriate, by including some herbal medicines on the National List of Essential Drugs (List of Herbal Medicinal Products), which can be divided into two groups:⁽²⁶⁾

1. Herbal medicines the use of which is based on traditional knowledge. Three traditional medicinal preparations were selected for the treatment of productive cough, fever and menstrual irregularity.
2. Herbal medicines that have been (scientifically) developed. Various dosage forms of single herbal medicines from the following five medicinal plants were selected, namely:
 - ❑ Turmeric for dyspepsia
 - ❑ *Senna alata* for constipation
 - ❑ *Andrographis paniculata* for pharyngotonsillitis and diarrhoea
 - ❑ *Zingiber cassumunar* for bruises and muscle sprains
 - ❑ *Clinacanthus nutans* for herpes simplex and herpes zoster infection of the skin, cold sores, skin rash, hives and itching.

A working group was recently appointed in April 2005 by the Subcommittee on the Development of the National List of Essential Drugs to select more herbal medicines for inclusion on the list of essential drugs so that doctors will have more herbal medicines to choose from in place of modern medicines.⁽³⁰⁾

According to the Drug Act B.E. 2510, herbal medicines registered as traditional medicines must be sold in licensed drug stores, while no license is required to sell traditional household remedies, meaning that they can be sold anywhere. Therefore, to increase public access to herbal medicines, in 1999 the Ministry of Public Health issued the notification on “traditional household remedies” naming 27 Thai traditional medicinal preparations, with detailed formulae, indications and dosages, as traditional household remedies. In addition, the notification also specifies the list of crude drugs that can be used as ingredients in 25 groups of traditional household remedies.⁽³¹⁾ As a result,



more herbal medicinal recipes have later been registered and sold as traditional household remedies, which enable easier access by the public to these herbal products than ever before.

Government policy on the promotion of Thai herbal products industry

The Thai government recognizes the importance of herbal products to the health of the Thai people and to the economy owing to the increased demand from the domestic and global markets. On 10 April 2001, the government therefore appointed the “Committee for the Development of Herbal Products Industry”, headed by the Minister of Public Health; the Committee and its subcommittees then formulated the “Strategic Plan for the Development of the Herbal Products Industry” for the years 2005-2009, which was approved as the national plan by the Cabinet on 29 June 2004. The Strategic Plan is divided into eight areas: namely, R&D, production of good quality raw materials, standards and quality control, improvement of manufacturing standards, marketing, amendment of the laws, knowledge management and collaborative mechanisms. The Plan identifies government offices from different ministries and universities as responsible for the implementation of the plan and to achieve the goals of each area of development. The Ministry’s Department of Medical Sciences serves as the coordinating centre. Under the Plan, 11 medicinal plants and one herbal preparation have been chosen as the target of R&D for development into new herbal products.⁽³²⁾

In addition, on 29 June 2004 the government also approved the “Strategic Plan to Develop Thailand as the Centre of Excellent Health Care of Asia” in the next five years, which will be implemented during the period 2004-2008. One of the purposes of this Plan is to develop Thailand as “The Origin of Precious Herbs for Superior Health”. The Plan aims to promote Thai herbal products among tourists by improving the quality of Thai herbal products in 10 major tourist destination provinces that have the potential to produce herbal dietary supplements, health foods, cosmetics, personal care products and spa products.⁽³³⁾

According to the policies of the government, presented to parliament on 23 March 2005, TTM will still be a part of the national health policy as the government will “*develop, transfer, and protect the wisdom of Thai traditional medicine, indigenous medicine, alternative medicine and medicinal plants*”. DTAM, in collaboration with other related organizations, will therefore be responsible for the implementation of this policy by:

- ❑ Strengthening the knowledge of TTM/IM (indigenous medicine)/ CAM (complementary and alternative medicine) through R&D,
- ❑ Transferring the selected knowledge of TTM/IM/CAM to the public and health-care personnel through training, demonstrations, exhibitions, printed matter and various other media channels,
- ❑ Developing herbal products and TTM/IM/CAM services to meet international standards.



The production of herbal medicines by the pharmaceutical industry and hospitals

As the recommendation of medicinal plants for PHC has increased public awareness of the health benefits of Thai herbs, together with the “back to nature” trend during the past 10 years, the demand for Thai herbal medicines has increased significantly. Traditional medicine manufacturers, the Government Pharmaceutical Organization, and some hospitals have therefore developed single herbal medicines into easy-to-use dosage forms to satisfy consumers’ demand. The total number of Thai traditional medicine manufacturers increased by 39.8 per cent from 616 in 1997 to 861 in 2003, of which 279 were in Bangkok and 582 were located in other provinces.⁽³⁴⁾ Information from FDA indicates that the cumulative number of traditional medicines locally produced and imported for human and veterinary use registered during the period 1983-2004 was over 10,000 preparations; of these, 5,816 were registered during the period 1983-2000.⁽³⁵⁾ Table 1 shows the increased number of registered traditional medicines and the annual production value of traditional medicines during the period 1994-2001.^(35,36)

Table 1 Number of locally produced traditional medicines for human use registered annually, and the production value of traditional medicines for human use during the period 1994-2001

Year	Number of locally produced traditional medicines for human use registered annually	Production value of traditional medicines for human use (millions of baht)
1994	141	414.9
1995	175	303.5
1996	248	318.2
1997	199	251.8
1998	492	485.0
1999	444	548.3
2000	422	675.3
2001	637	736.9

However, when compared with the value of modern medicines, in 2001 the production and imported values of traditional medicines were only about 2 per cent of that of modern medicines.^(36,37) This is partly because most of the traditional medicine manufacturers in Thailand operate on a small to medium scale and only a few are large-scale industries. Therefore, both the public and private sectors still have a lot of work to do to improve this industry and to increase the demand for their products.

Regarding the production of herbal medicine by hospitals, as of 2000 there were 168 community hospitals, 22 health centres and 7 regional/general hospitals that produced herbal medicines and other herbal products to serve the community and nearby hospitals in their regions.⁽³⁸⁾ Taken together, these hospitals currently make single-herbal preparations from more than 35 medicinal plants into various dosage forms for internal and external uses. In some cases, the raw materials for production are grown and processed by



people in nearby communities via contract farming, according to the specifications set by the hospitals. Hence, the production of herbal medicines not only generates income for the hospitals but also helps to create jobs, income and self-reliance in terms of health care for the community.

The best example of such a hospital is Chao-Phraya Abhaibhubejhr Regional Hospital in Prachinburi, which began production of a few preparations of herbal medicines for its patients about 20 years ago. Later on the hospital established the Chao-Phraya Abhaibhubejhr Hospital Foundation, which produces and sells a wide variety of GMP-standard herbal products. Currently, the Foundation manufactures 29 items of herbal medicine in various dosage forms, 31 herbal cosmetics and personal-care products, and 8 herbal teas and drinks, on a commercial scale and sells the products nationwide, producing an income of several million baht a month. The hospital also produces organic herbal products by collaborating with local medicinal plant growers to improve their farm and cultivation standards in order to become certified as organic. Hence, the success of the hospital has partly been due to community participation and this in turn helps the community to improve the environment and contributes to the community's well-being.⁽³⁹⁾ In addition, the hospital also initiated a health tourism programme for tourists to join various health promotion programmes, i.e., health food, exercise, Thai massage, herbal steam baths, meditation, yoga training, learning about holistic medicine and TTM, and to visit various tourist attractions in Prachinburi Province.⁽⁴⁰⁾

6.2 Thai massage, or *nuad thai*

Thai traditional massage or *nuad thai* is a branch of TTM and a form of manual therapy that can be used for health promotion or relaxation and can also effectively cure or relieve several symptoms and diseases, e.g., myofascial pain syndrome, frozen shoulder, carpal tunnel syndrome and tension headache. Thai massage can be divided into two categories, i.e., folk massage and royal massage. Both types of massage are based on the principle of *sen sib* or 10 (*sib*) primary energy lines (*sen*), and were developed, refined and passed on from generation to generation over the years. The techniques of folk massage vary in different regions of the country; however, the similarity is that they all use hands, elbows, knees and feet to massage, press, bend, or stretch the body parts and to apply pressure and manipulate the body. In contrast, royal massage emphasizes the use of the hands and fingers to apply pressure to the acupressure points associated with the 10 energy lines.⁽⁴¹⁾ Furthermore, Thais also produced different forms of wooden massage instruments that could be used for self-massage and health promotion.⁽²¹⁾

The "Health and Development Foundation" is an NGO that initiated the "Revival of Thai Traditional Massage Project" in 1985. The project is aimed at reviving Thai massage and promoting its use in PHC to decrease the use of pain-reliever medicines. Under this project, the Foundation provides training courses on Thai massage for the public, publishes a manual of Thai massage, produces audiovisual media teaching aids, compiles and revises the body of knowledge on Thai massage of different schools and improves the standards of massage practice.^(1,38)



ITTM has also played an important role in the revival and revision of different forms of Thai massage. Thailand suffered a financial crisis in 1997, after which ITTM received 62 million baht in government funding (in 1999) to organize training courses on Thai massage in order to create jobs for people who had lost their jobs; consequently, about 4,000-5,000 people were trained. ITTM also reviewed the styles of Thai massage of different schools and developed standards for different types of massage and massage training curricula. The four main massage curricula of the Ministry of Public Health developed by ITTM are:

1. Curriculum on foot massage for health (60 hours)
2. Curriculum on Thai traditional massage for health or relaxation (folk massage-150 hours)
3. Thai traditional massage curriculum (royal massage-372 hours)
4. Thai traditional massage curriculum (royal massage-800 hours).⁽⁴²⁾

As a result, many schools that teach Thai traditional massage have now adopted these curricula for their teaching. Moreover, the TTM Professional Committee recently developed and announced a two-year curriculum for Thai massage with minimal training of 800 hours.

Regarding the teaching of Thai massage, ITTM has continuously promoted Thai massage among the public by providing training, making various teaching aids and distributing them to public health service facilities and TTM Health Promotion Centres throughout the country so that massage-training courses can be offered to the public nationwide.

Currently, Thai massage is not only well liked by Thai people but is also becoming popular and well known worldwide as some world-class spas and resorts are now offering Thai massage in their service menu; hence, Thai masseurs and masseuses are now in great demand by the global spa industry. With a view to consumer safety, DTAM together with the Department of Labour have established standards for Thai massage based on the Ministry's curricula:⁽⁴³⁾

- Level I - Thai traditional massage for health and relaxation (150-hour curriculum)
- Level II - Thai traditional massage for relieving symptoms (372-hour curriculum)
- Level III - Thai traditional massage for therapeutic purposes (800-hour curriculum).

The second and the third curricula involve the study of royal massage, which is regarded as "Thai therapeutic massage". Persons who finish these courses would be able to treat about 10 and 35 symptoms and diseases respectively.

For people interested in learning Thai massage for health promotion for family members, foot massage for health or Thai foot reflexology and Thai massage for health and relaxation, these courses would seem to be appropriate because they do not take a long time to learn. Moreover, they only could



provide massage for themselves and their family members but also could make a living as massage service providers. However, if one is interested in basic Thai therapeutic massage for the relief of common pain symptoms of the muscles and stress-induced headache, the 372-hour curriculum should serve the purpose.

On 1 February 2001, the Ministry of Public Health issued a Notification stating that Thai therapeutic massage is considered as a branch of TTM practices. Therefore, before a trained masseur/masseuse can provide massage therapy, he or she must register and obtain a license as a “TTM practitioner in the field of Thai massage”.⁽⁴⁴⁾ Meanwhile, Thai massage for health or relaxation, not meant for therapeutic purposes, is allowed and is not under the same regulation. In this case, massage service providers are under the control of another Notification issued by the Ministry on 21 April 2004. They must be over the age of 18 and have passed massage-training courses offered by certified public or private institutions, or have at least one year of experience in massage for health or relaxation services and have passed the test of knowledge and experience offered by an established central committee.⁽⁴⁵⁾

As of March 2005, there were 97 schools, institutes, or foundations offering training courses on Thai massage that had been approved by the Central Committee.⁽⁴⁶⁾ The drastic increase in the number of schools that teach Thai massage is due to the current high demand for Thai massage service providers and Thai spa therapists to serve in the spa business, both at home and abroad.

6.3 Hot herbal compresses and herbal steam baths

Hot herbal compresses have been used for hundreds of years by Thais to relieve muscle sprains, muscular and joint pain and discomfort. The herbal compress called *luk pra kob* in Thai is a blend of herbs, including *plai* (*Zingiber cassumunar* rhizome), turmeric, lemongrass, kaffir-lime peel, with salt, camphor and borneol camphor wrapped and tied in a cotton cloth to make a round-shaped ball with a handle on top. Before its application to the affected areas of the body, *luk pra kob* must be steamed for about 10-15 minutes. The heat helps to increase the regional blood flow and the release of volatile oils from the herbs helps to exert anti-inflammatory action on the affected muscles.^(6,47) Research has shown that *plai* and turmeric possess anti-inflammatory activity, and clinical evidence indicates that *luk pra kob* can relieve myofascial pain⁽⁴⁸⁾ and knee osteoarthritis.⁽⁴⁹⁾ Hot herbal compression can be used alone or in combination with massage to relieve musculoskeletal pain and inflammation.⁽⁴¹⁾

Herbal steam baths, based on TTM, can be used for therapeutic or health promotion purposes. The principle of a herbal steam bath is to boil a combination of herbs and volatile substances, similar to those used in hot herbal compresses, in a steam room or a closed chamber. The steam and the volatile substances that contact the skin exert a local effect, and when inhaled, will affect the respiratory system and exert a systemic effect. The health benefits of a herbal steam bath are, i.e., stimulation of the circulatory and respiratory systems, relief of muscle tension and pain, skin rash and stress,



nourishment of the skin and improved excretion of body waste; originally it was used for postpartum care.^(6,47)

Both hot herbal compresses and herbal steam baths are TTM services that are provided in many public health service facilities and are now commonly found on the Thai spa service menu to improve general health, rid the body of toxins and improve blood circulation. *Luk pra kob* is also well received by spa businesses abroad and among foreigners who love natural health-care products. *Luk pra kob* made of dried herbs and pasteurized fresh product packed in cans are now becoming important export items in the herbal product category and generating good income for Thai medicinal plant growers.

6.4 The practice of *dhammanamai*⁽⁶⁾

Dhammanamai is the application of Buddhist teachings in TTM for holistic health care of the body, the mind, the society and the environment. The principle of *dhammanamai* was founded by Professor Dr. Ouay Ketusingh, the founder of applied TTM. The practice of *dhammanamai* corresponds with the principles of health promotion, as it will enable people to increase control over the determinants of health and thereby to improve their health in order to achieve a state of complete physical, mental and social well-being. The practice of *dhammanamai* can be divided into three areas, namely, *kayanamai* (healthy body), *jitanamai* (healthy mind) and *chevitanaamai* (healthy lifestyle).

6.4.1 *Kayanamai* (healthy body)⁽⁶⁾

According to TTM, the human body starts deteriorating after the age of 32. Therefore, in order to stay healthy for as long as possible and prevent diseases, one needs to take care of the body by exercise and eating right. Regarding exercise, *ruesi dud ton* is a Thai body exercise suitable for all ages because it is not a high-impact exercise and can help to adjust the balance of the body structure.

6.4.1.1 *Ruesi dud ton* or Thai traditional stretch exercise

Ruesi dud ton, or Thai traditional stretch exercise, is another manifestation of Thai traditional wisdom related to health care that can be used for health promotion, disease prevention and rehabilitation of some minor disorders. *Ruesi* means “hermit” and *dud ton* means “body stretch exercise”. The word *ruesi dud ton* is derived from the belief that in the past hermits who resided in the forest to seek enlightenment usually sat in one position for a long time while doing meditation. They then created and performed a series of stretch exercise to relieve the muscle fatigue and stiffness that occurred after long hours of meditation. While performing *ruesi dud ton*, one also practises breathing exercises and meditation by focusing on breathing rhythm. Hence, the health benefits of *ruesi dud ton* are increased body agility and muscle coordination, stimulated blood circulation and promotion of good concentration.

To educate people about *ruesi dud ton*, in 1836 King Rama III ordered the building of 80 *ruesi dud ton* statues made of a mixture of zinc and tin in different postures. They were placed in Wat Po together with marble tablet



inscriptions in poetic form describing the health benefits of each posture. These *ruesi dud ton* casts can still be found at Wat Po.^(41,50)

ITTM selected 15 basic *ruesi dud ton* postures, out of a total of 127 postures, as suitable for people of all ages. The selected postures cover the exercise of all parts of the body from head to foot to be promoted for health promotion and to help adjust the balance of the body structure. To educate the public about *ruesi dud ton*, ITTM publishes booklets and makes videos and CDs that can be used for training and self-study.⁽⁴¹⁾

6.4.1.2 Eat right according to TTM^(4,6)

Our Thai ancestors integrated the knowledge of TTM into daily life using food and drink to balance the basic elements of the body and soul and to stay healthy. Based on the principles of TTM, changes in the weather or the external elements during different seasons can adversely affect the balance of the body's elements and health. Medicinal plants, vegetables and fruits with different tastes, possessing different health benefits as well as affecting the body elements differently, are therefore suitable for people with different dominant basic elements and are suitable for consumption during different seasons.

For example, vegetables and fruits that help reduce body heat during summer are those with a bitter or cool and bland taste, e.g., bitter melon, bitter cucumber, watermelon, morning glory tips, pumpkin, sweet potato, okra, eggplant, Chinese chive, horseradish-tree pod and young inflorescence of Siamese neem. On the contrary, spicy or greasy food is not suitable during summer because it will be a fire element in the body and generate more heat. Meanwhile, vegetables and fruits suitable for the rainy season and the dry season are those that are used as spices.

6.4.2 *Jitanamai* (healthy mind)⁽⁶⁾

Jitanamai is the training and strengthening of the mind so that one will be able to focus and concentrate better by practising meditation, studying and following Buddhist teachings or other religious beliefs based on one's faith, which will eventually help to sharpen one's mind and intellect. The health benefits of daily practice of meditation are:

- Induce mental relaxation, inner peace and happiness,
- Increase working efficiency owing to improved concentration, and
- Relieve stress, enhance the immune system and help to prevent psychosomatic disorders.

A well-trained mind would then lead to good thoughts that help to guide a person to choose a healthful way of life and not easily give in to self-indulgence. In addition to meditation, the practice of *jitanamai* also includes saying prayers, behaving well with family members and others, and extending love and kindness to others, which all are a part of the religious practices of all faiths.



6.4.3 *Chevitana*mai (healthy life)⁽⁶⁾

*Chevitana*mai is to lead one's life by following the "Middle Path" of Buddhist teachings and to earn one's living doing a good and honest job and always abiding by the law. In addition, *chevitana*mai also includes keeping one's home and environment in good, clean and healthy condition, which will eventually lead to a peaceful mind and healthy life.

7. TTM services in the public health service facilities

To promote the use of TTM for health promotion, it is necessary to provide the public with easy access to TTM services by integrating such services into public health-care facilities and disseminating TTM knowledge to the public. Initially, the number of health service facilities that provided TTM services were small and the only service was prescribing herbal medicines. After the Seventh Health Development Plan (1992-1996) took effect, integration of TTM into the health service system began, i.e., treating with or selling herbal medicines to patients, providing Thai massage, hot herbal compresses and herbal steam baths, and producing herbal medicines in some hospitals.

Currently TTM services are available through various channels, namely:

1. *TTM clinics* operated by licensed TTM or applied TTM practitioners, or belonging to the universities or institutes that teach TTM.
2. *Community or provincial/general hospitals* that have set up their own TTM section to provide TTM services.
3. *TTM Health Promotion Centres*, which have been set up and supported by ITTM in community or provincial/general hospitals, as models of TTM service centres in every province, a total of 150 centres (two centres per province) have been established so far.
4. *Drug stores* that sell registered Thai traditional medicines and traditional household remedies and general stores that can sell only traditional household remedies.

Community or provincial/general hospitals or health service centres in the Ministry of Public Health that provide TTM services can be divided into four levels,⁽³⁸⁾ namely:

- Level 1 – Those that sell herbal medicines only.
- Level 2 – Those that sell herbal medicines AND also provide TTM services, e.g., Thai massage, hot herbal compresses and herbal steam baths.
- Level 3 – Those that provide level 2 services AND also serve as a TTM training centre, e.g., training in Thai massage or *ruesi dud ton*.
- Level 4 – Those that provide level 3 services AND also produce herbal medicines.



According to an ITTM survey, in 2003 the number of health service facilities that provide any level of TTM services were as follows:

Regional / general hospitals	80/96	(83.3%)
Community hospitals	492/726	(67.8%)
Health centres	2,169/9,683	(22.4%)

Regarding the national health security system, the types of TTM services covered by the Universal Coverage Programme currently are: ⁽⁵¹⁾

1. Treatment and diagnosis with
 - 1.1 Thai traditional medicine
 - 1.2 Applied Thai traditional medicine
2. Treatment and rehabilitation with
 - 2.1 Traditional herbal medicines or traditional recipes comprising medicinal plant materials
 - 2.2 Therapeutic massage for treatment and rehabilitation
 - 2.3 Herbal steam baths for therapeutic purposes
 - 2.4 Hot herbal compresses for therapeutic purposes

8. Dissemination of TTM knowledge to the public through the mass media

To increase public awareness of the health benefits of TTM and to promote TTM practices for health promotion, ITTM has disseminated knowledge of TTM in various forms over the years. Books, videos, VCDs, posters, pamphlets, etc., have been published and made and distributed directly to the public via all levels of hospitals and health service centres all over the country; different forms of media, e.g., radio, television, newspapers, web sites and the Internet, have been used. Weekly seminars opened for the public on various subjects of TTM, indigenous medicine and alternative medicine are held every Wednesday at DTAM in the Ministry of Public Health, Nonthaburi Province. In addition, ITTM also presents TTM wisdom to the public in the forms of exhibition on various occasions at home and abroad. Besides ITTM, several schools of pharmacy at different universities, schools of TTM, and some TTM practitioners or NGOs have also published textbooks about medicinal plants and their therapeutic value, and on principles of TTM to empower people to use TTM for health promotion.

Last year, DTAM held “The First Congress on Thai Traditional Medicine, Thai Indigenous Medicine, and Alternative Medicine” commonly known to the public as “The First National Exposition of Medicinal Plants”. The five-day exposition comprised seven main activities, namely, technical meetings (panel discussions and paper presentations), short-course training, exhibitions of folk medicine, medicinal plant gardens, a one-stop service for the development of herbal products, a showcase of traditional medicine from foreign countries and the sale of herbal products. The exposition was very successful, with about 300,000 people attending, and over 3,600 people attending the technical meetings and over 3,000 receiving short-course training.



9. Lessons learned and suggestions

The importance of the government policy on TTM

It is clear that the government's policy on the promotion of the use of medicinal plants and TTM has played a crucial role in the revival and integration of TTM in the health-care system, as stated in the Fourth (1977-1981) to the Ninth (2002-2006) National Economic and Social Development Plans. Initially, the policy and budget allocation placed emphasis on the promotion of medicinal plants in PHC and on R&D of new drugs made from medicinal plants. Later on the Seventh to the Ninth Health Development Plans (1992-2006) promoted the development of TTM knowledge, indigenous medicine (IM), and later complementary and alternative medicine (CAM) through research and the improvement of TTM/IM/ CAM service standards for successful integration into the health system and for health promotion through self-care. Therefore, the number of hospitals and health centres that provide TTM services has significantly increased, especially during the past five years. Fiscal budgets have also been allocated to DTAM to support the establishment of two TTM Health Promotion Centres per province, with a total of 150 centres nationwide, to distribute TTM services and provide training for people nationwide and to serve as models of TTM clinics.

Hence, it is clear that government policy and financial support are the main driving force that have brought traditional medicine services to the public and helped increase people's awareness about its role in health promotion. Moreover, the fact that public hospitals manufacture, use and sell herbal medicines and provide services and training for the public will help to build confidence in and demand for traditional medicine and herbal medicines among the public.

Social mobilization and strengthening community action

The "back-to-nature" and "health conscious" global trends that have gone on since the 1990s have partly contributed to the welcoming and acceptance of herbal medicine and dietary supplements as a means of health care and health promotion in Thailand and many other countries around the world. As herbal medicines and other natural products for health and beauty are regarded as safer products than chemical-based ones and the number of consumers who prefer such products has gradually increased, the domestic and global markets for these products have greatly expanded.

In addition, the establishment of an official office responsible for the implementation of the policy, e.g., ITTM and later DTAM, has contributed to the success of the promotion and integration of traditional medicine in the health-care system. Hence, it is important that such an office must be established to play an active role in formulating policy and implementing plans by collaborating with other health-care facilities, NGOs and communities to create awareness and participation. Community action will eventually result in public acceptance and participation in the use of traditional medicine as a part of health promotion and health care nationwide. Chao-Phraya Abhaibhubejhr Regional Hospital and nearby communities in Prachinburi Province mentioned previously are at the forefront of community participation that later creates social mobilization concerning the use of TTM and herbal products for health promotion and helps to accelerate the integration of TTM into the health-care system.



Empowering people with evidence-based TTM for health promotion

Although the classical TTM textbooks are considered invaluable sources of national wisdom containing some good therapeutic methods and herbal remedies, with the current level of medical knowledge, some of the content may be considered erroneous or outdated. Hence, in order to gain acceptance from the public and the medical community and for improved consumer protection, it may be necessary for pre-clinical and clinical research to be undertaken to establish the quality, safety and efficacy of traditional medicines or therapies.

According to the policies of the National Research Council of Thailand (NRCT) and the Ministry of Public Health, research on the body of knowledge of TTM and R&D of new herbal drugs from medicinal plants are regarded as other important areas of health research in Thailand. The present government strongly supports integrative research projects that pool experienced researchers and resources from various universities and research institutes and are product-oriented and complete-cycled in nature via NRCT funding. It is therefore expected that scientific evidence to support the safety and efficacy of traditional medicines and herbal medicinal products will be available in the near future.

Regarding the conduct of clinical research to determine the efficacy and safety of traditional or CAM therapies or herbal medicines in patients, the Ministry appointed on 21 April 2003, the "*Ethics Committee for Research in Human Subjects in the Field of Thai Traditional and Alternative Medicine*", for which DTAM serves as the secretariat. The Ethics Committee has developed its own guidelines as well as following WHO and GCP guidelines when considering the clinical trial protocols submitted, and also giving ethical and scientific advice to researchers to improve their protocols. The appointment of this Ethics Committee should serve as a good example of a significant role that the Ministry can play to empower people with strong evidence-based traditional medicine required for health promotion and its successful integration into the mainstream health system.

10. Conclusion

Finally, similar to other countries, Thailand has its own form of traditional medicine which it considers as national wisdom for health care and it has the policy to integrate traditional medicine into the mainstream health-care system and to foster its use for health promotion. To reach this goal requires national policy and financial support from the government, the strengthening of the body of knowledge of traditional medicine, human resource development, the development of quality standards for herbal products and services, and the dissemination of traditional medicine knowledge to the public. All of these can be achieved by government commitment, good administration, an information system, R&D, certified educational system and training curricula, good collaboration among communities, the institutes and organizations concerned at both national and international levels.



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