

Review

## Suggestions how to promote clinical research by paramedical professionals

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### Abstract

Japan is the world top runner in terms of the society aging, with the longest life span, the highest ratio of the elderly people (65 years old and above), the highest ratio of the old-old people (75 years old and above), and the fastest transition from the aging to the aged society in 24 years.

Along with the transition into the super-aged society, Japan will need the significant restructuring of the paramedical professionals such as nurses, physiotherapists, occupational therapists, and medical engineers.

The profession of nurse has a long history of national qualification, but the history of physical therapists and occupational therapists is only 50 years, and that of clinical engineering technicians is only 28 years. The Certified Psychologist Bill was established in 2015, and the first national exam for certified clinical psychologist will be held in 2018 as the newly added nationally qualified profession in medical and caring service.

The purpose of this review is to give the reader the perspective view of the paramedical professionals and the training of those professionals because the educational system has been significantly changed, in which nurses and other paramedical professionals are educated and trained at university level.

Considering the purpose and the training system of those paramedical professionals at university level education, the author is proposing the new means of stimulating and promoting the research activity among paramedical professionals. The authors proposal is the integration of university level education and the training of the paramedical professionals in university educational system in Japan.

The practical method how to promote clinical research by paramedical professionals is discussed. The paramedical staff is directly facing with the patient as a whole, and the human subjectivity must be further added to the combination of all the clinical data. From this point of view, clinical research by paramedical professionals can be fully activated under the current medical education and training system. Paramedical professionals are facing the patients in the front line directly exposed with the humanistic interaction with the patient.

**Key words:** clinical engineer, clinical research, nurse, occupational therapist, physiotherapist, paramedical professional,

### 1. Introduction

The profession of nursing was introduced into Japan in the beginning of the Meiji Era along with the introduction of Western medicine in general, and the first nursing school was established in 1886 to train nursing experts. Initially nursing was regarded as women's occupation, and most of

nursing professionals were females. In 1948 the Nurse Midwife Bill was enacted to authorize the occupation of "nurse" as the national qualification, and the first national examination for nurses was conducted in 1950. In order to compensate the shortage of the registered nurses, the qualification of the associate nurse was enacted in 1951. Until the 1950s, nurses took care of all the hospitalized

patients care under the full nursing system, but in 1958 the nursing care system was changed from the full nursing to the standard nursing. All the attendant nursing care by non-qualified person was prohibited in 1997.

In the past, “female nurse” was the official title of nursing professionals because majority of the profession was actually carried by female, but the revision of the law in March 2002 has made both sexes as equally registered “nurses” regardless of gender. In the past, hospitals have been regarded as main workplaces for nurses, but nowadays due to the diversification of medical service and health care, nurses are expected to work in various places. Especially as Japan has become the super-aged society, the number of nursing care facilities and visiting care stations outside medical institutions have been increased targeting the elderly people, and care-taking knowledge is required for nursing staff in addition to the knowledge of nursing. In 2017, the 106th national exam for nurse produced 55,367 new nurses with the passing rate of 88.5%.

The profession of nurse has a long history of the national qualification, but the history of physical therapists and occupational therapists is 50 years, and the history of clinical engineering technicians is only 28 years. The Certified Psychologist Bill was established in 2015, and the first national exam for certified psychologist will be held in 2017 as the newly added nationally qualified profession in medical and caring service.

## 2. Perspective picture of paramedical occupation

The qualification of medical and healthcare professionals are under the jurisdiction of the Ministry of Health, Labor and Welfare in Japan. The core qualified professional in medicine and health care are medical doctors (303 thousand), pharmacists (280 thousand) dentists (102 thousand) (the number of actively working profession are in parenthesis as of 2012). These occupations are entitled by passing the national exam after completing 6 years of university education to play the core role in medical service.

Currently there are 1.4 million qualified care workers, the most number of working force in health care service, which is eligible to take the qualification exam after completing 3 years of practical experience as training practitioners, and no university education is required.

Here we describe the professionals which are eligible to take the national exam after completing

the specialized curriculum at the university or vocational school. Table 1 shows 23 types of medical professions certified by national qualifications in Japan, together with the number of personnel (Table 1). There are 1087 thousand nurses actively working (1427 thousand including assistant nurses), social workers (190 thousand), clinical laboratory technicians (180 thousand), dental hygienists (116 thousand), acupressure massagers (113 thousand people), acupuncture (10.8 thousand), and physiotherapist (100 thousand persons) and so on in the decreasing order.

The number of candidates for the latest national exam, the number of successful candidates, and the passing rates are shown in Table 2. Those with a high pass rate are observed with speech therapists (94%), diagnostic radiology technicians, public health nurses, etc. On the contrary, occupations with a low pass rate are seen with occupational therapists (64.4%), and visual technicians (67.6%) (Table 2).

These occupations are called co-medicals or paramedical professionals, and at Aino University, nurses, physiotherapists, occupational therapists, and clinical engineering technicians are trained among these paramedical qualifications. Although the clinical psychologist is not yet a national qualification at the present day, the Certified Psychologist Bill was established in 2015 and the first national qualification exam is scheduled in 2017. Therefore, although the number of qualified certified psychologist is undecided, the number of clinical psychologists currently active is cited.

### 2-1. Nurse

Nurse is the representative occupation of paramedical staff. Together with medical doctors, it is the core professional in medical care service. The number of nurses is 1,087 thousand (1,427 thousand including assistant-nurses), and 11.0 nurses per 1,000 people. The number of nurses in Japan has been increased 1.23 times compared with that in 10 years ago (Figure 1). The number is less than those in Switzerland (17.6 people) and Northern European countries (Norway (16.9 people), Denmark (16.5), Iceland (15.3), Finland (14.1)), and the number of nurses per capita is comparable with other developed countries (data in 2014). (Table 3).

According to statistics of FY 2014, 61.0% are working in hospitals, 20.7% are in clinics, and other nurses are working at home care (3.4%), geriatric health care institutions (2.8%), visiting nursing (2.5%), elderly welfare facilities (2.4%),

Table 1 Numbers of paramedical professions nationally qualified

qualification	number (thousand)	qualification	number (thousand)
Nurse	1087	Judo therapist	64
Assistant nurse	340	Public health nurse	48
social worker	190	Supervising nutrition	36
clinical laboratory technician	180	Midwife	34
dental hygienist	116	Dental technician	34
Massage finger pressure therapist	113	Clinical engineer	32
Acupuncture therapist	108	Emergency medical technician	30
Moxibustion therapist	106	Speech language hearing therapist	25
Physiotherapist	100	Clinical psychologist	25
Occupational therapist	70	Ophthalmologic technician	11
Psychiatric social worker	69	Orthotist	5
Clinical radiologic technician	69		

Table 2 Results of National Exams for medical and healthcare professionals in 2016

Medical and Healthcare Profession	the XXth national exam	number of applicants	successful applicants	passing rate (%)
Medical doctor <sup>a)</sup>	110	9434	8630	91.5%
Pharmacist <sup>a)</sup>	101	14949	11488	76.9%
Dentist <sup>a)</sup>	109	3103	1973	63.6%
Moxibustion therapist	24	2008	2003	99.8%
Speech language hearing therapist	18	1,114	1104	99.1%
Clinical radiologic technician	25	7,233	6944	96.0%
Public health nurse	102	886	833	94.0%
Clinical Engineer	102	8,799	7901	89.8%
Nurse	105	62,154	55585	89.4%
Physiotherapist	51	6,102	5344	87.6%
Emergency medical technicians	39	7,116	2472	86.1%
Orthotist	24	1,687	1422	84.3%
Midwife	29	233	196	84.1%
Accupuncture therapist	24	3,016	2377	78.8%
Dental technician	62	4,400	3363	76.4%
Massage finger pressure therapist	24	4,732	2550	75.0%
Medical Technician	51	12,515	9272	74.1%
Dental Hygienist	24	4,775	3504	73.4%
Judo therapist	29	2,739	1987	72.5%
Ophthalmological technician	18	2,553	1725	67.6%
Occupational therapist	24	7,115	4582	64.4%
Psychiatric social worker <sup>b)</sup>	18	7173	4417	61.6
Care helper <sup>b)</sup>	28	152573	88300	57.9
Social worker <sup>b)</sup>	28	44764	11715	26.2

a) medical professions requiring 6 year university education, b) professions mainly in welfare fields

municipalities (2.3%), social welfare facilities (1.6%), educational institutions (1.1%), private enterprises (0.7%), public health centers (0.5%), infant care institutions (0.1%) (Table 4).

Training system of nurses in Japan has changed greatly from vocational schools to university-centered training. Previously, the training course for nurses was mainly carried by vocational school for 3 years course after graduating from high school. From the 1990's, discussions began to deliberate nursing education to 4-year curriculum.

Before the revision of the law, most of the nurse training institutions, in particular, prefectural (public) high school nursing schools, shifted to nursing university and nursing department of existing prefectural university. The traditional highly reputed nursing schools run by the Red Cross Association and the nursing high schools attached to the medical university have also been rapidly advanced to nursing universities and nursing departments of medical schools. As a result, the number of nursing universities has

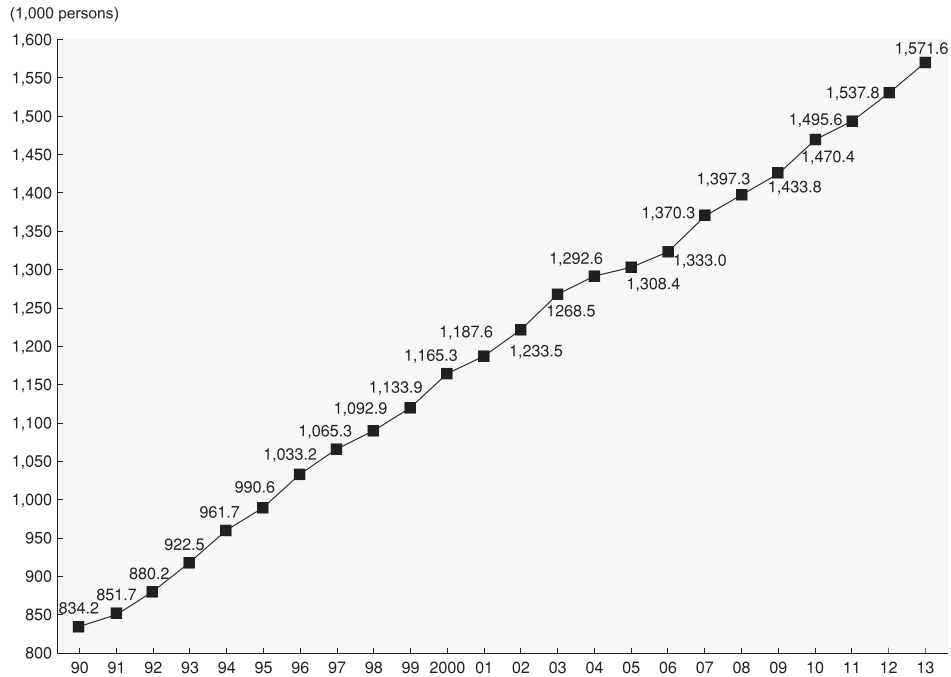


Fig 1 Number of medical and health care professions in Japan

Table 3 Number of nurses in Japan and some Western countries

Country	Year	Population (A)	Beds (B)	Nurses (C)	B/A	C/A
Japan	2012	127,515	1,703,853	1,344,388	13.4	10.5
Canada	2012	34,880	93,525	326,227	2.7	9.4
USA	2012	314,112	920,829	3,498,450	2.9	11.1
Denmark	2011	5,571	17,433	88,999	3.1	16.0
France	2012	63,519	414,672	595,594	6.5	9.4
Germany	2013	80,646	667,560	1,045,000	8.3	13.0
Sweden	2012	9,519	24,927	106,176	2.6	11.2
United Kingdom	2013	63,238	176,789	524,277	2.8	8.3

Table 4 Change in Number of Employed Nurses

Year	Grand total	Increase over previous year	Index	Hospitals	Clinics	Home services etc.
2005	1308409	15816	100	(62.6) 818,580	(21.7) 283,623	(2.5) 32,228
2006	1333045	24636	101.9	(62.4) 831,921	(21.8) 290,929	(2.5) 33,923
2007	1370264	37219	104.7	(62.2) 851,912	(21.7) 297,040	(2.8) 37,695
2008	1397333	27089	106.8	(62.2) 869,648	(21.4) 299,468	(2.6) 35,826
2009	1433772	36439	109.6	(62.2) 892,003	(21.2) 304,247	(2.7) 38,866
2010	1470421	36,649	112.4	(62.0) 911,400	(21.0) 309,296	(2.9) 42,946
2011	1495572	25151	114.3	(62.0) 927,289	(20.7) 309,954	(3.0) 44,395
2012	1537813	42,241	117.5	(61.4) 944,640	(20.9) 320,800	(3.2) 48,600
2013	1571647	33,834	12001	(61.2) 962,019	(20.8) 326,132	(3.3) 52,101
2014	1603108	31,461	122.5	(61.0) 977,654	(20.7) 331,443	(3.4) 54,514

exceeded 200 in FY2012 compared to only 10 schools a decade before. In contrary, nursing junior colleges, 70 schools in the past, decreased to about 30 schools. Then, in July 2009, the “Nurse and Midwife Act” was revised in which nurse education has been transferred in charge of the

Ministry of Health, Labor and Welfare, and the Ministry of Education, Culture, Sports, Science and Technology, which clearly concluded that the training of nurses should be based on a 4-year university graduate (requiring bachelor’s degree).

Because of these circumstances, the current

nursing training course is somewhat complicated. After graduating from a senior high school, a person will be granted the qualification by one of the followings; 1) graduation from nursing university or college, 2) completion of integrated curriculum at designated training facility in 3 years (or 4 years of study), 3) graduation from nursing junior college (3 year course), 4) graduation from nursing training schools (3 year course).

There are some high schools specialized for nursing. After graduating from junior high school, a person can go to nursing senior high schools to be assistant nurses, and then they can be qualified to be nurses after completing 2 years of study course in nursing junior college or in nursing vocational training schools for 2 year term (Fig. 2).

There are 241 nursing universities (42 national, 48 public, 154 private schools), 21 junior colleges (one public school, 20 private schools) and 473 vocational schools. The nursing training curriculum has been greatly revised since FY 2009. The characteristics of nurse education are to learn in practice, and about one third of the curriculum is devoted to clinical practice. In the 3-year course, 97 units, 3,000 hours or more learning is the requirement to obtain a nurse's license, among which the practical training is 23 units 1,035 hours.

**2-2. Physical Therapist**

Physical therapists are professionals who conduct exercise-based therapies and training to maintain and to improve the functional recovery

and activity of daily living. The means of physical therapy cover exercise therapy, physiotherapy, daily living motion training, and use of prosthetic limbs and wheelchairs. The target diseases range from pediatric to the elderly, including diseases of the central nervous system, orthopedic diseases, cerebral palsies, and internal diseases.

There are 102 universities (14 national, 10 public, and 93 private schools) that train physical therapists, accepting 5087 students into the course of physical therapists each year. There are 6 junior colleges for physical therapists which are all private schools (370 in the daytime and 40 in the nighttime course). There are 150 vocational schools, of which 66 schools (3,093 in the daytime and 630 in the night) are 3 year course, and 84 are 4-year course (3,790 in the daytime and 850 in the night) (Figure 3).

Owing to the increasing number of people with disabilities due to accidents and disasters, the demand of therapists is extremely high in these days.

**2-3. Occupational Therapist**

Occupational therapists are the profession to encourage independent living for people with physical disabilities, people with disabilities in the mind, children with disabilities, elderly people with dementia, and others, so that they can acquire their social life capacity. Occupational therapy aims at amplifying applied or social adaptive capacity, while physical therapy primarily aims to restore fundamental operational ability. There are various types of activity available in

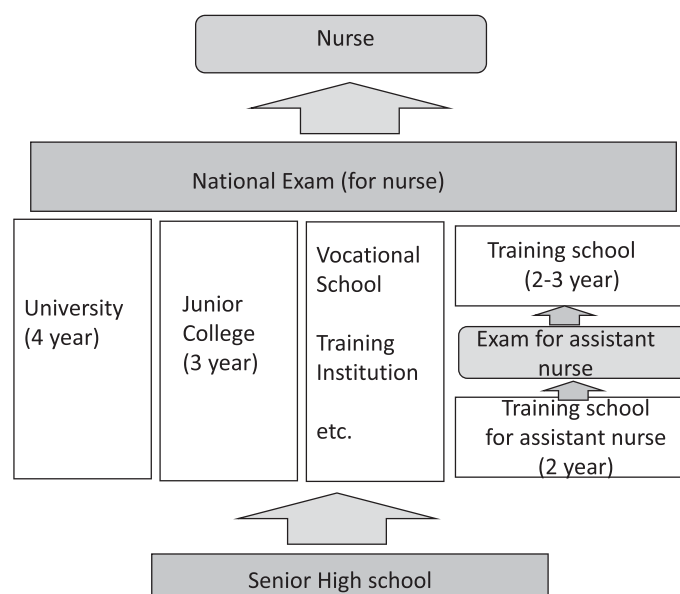


Fig. 2 Training courses for nurse

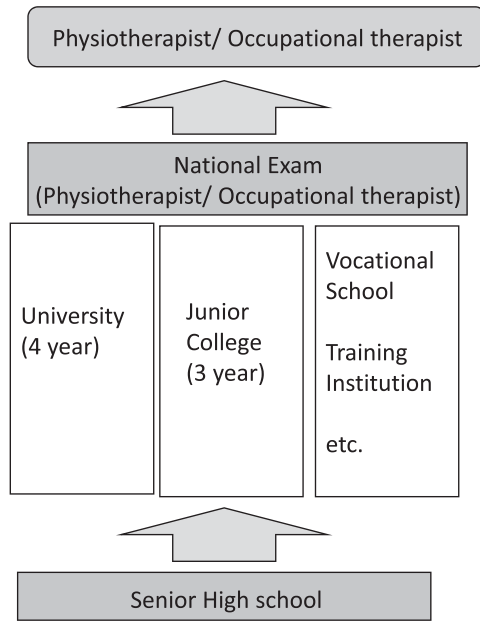


Fig. 3 Training courses for physiotherapist and occupational therapist

occupational therapy, including knitting, handicraft, fabric, pottery, doll making, copper/leather/bamboo work, woodworking, gardening, farming, play, music performance, games, and sports. The therapists select items that can be participated positively, and try to raise their ability to recover to their families and adapt to real life through their work.

Occupational therapy is often divided into physical functional occupational therapy, daily living motion training, psychological supportive occupational therapy, and occupational preoperative therapy. Physical functional occupational therapy aims at adaptation to actual daily life and social activities mainly by upper limb movement exercises such as grasping, gauging, pinching, pinching, etc. At the same time, balance and durability of the overall function are also the target of training by occupational therapist. In daily living movement training, training for acquiring practical daily living behavior, by selection of self-help tools according to the type and degree of disability of the person, and actual living capacity at home is introduced, produced, and evaluated. In psychological supportive occupational therapy, the patients are supported and taught from the mental perspective through concrete and meaningful work so that patients will not lose their positive willing to recover themselves. In occupational preoperative therapy, after evaluating the quality of work, through training in the preferred direction for occupation participation of people with

disabilities, the therapists help the patients to have sustainability, efficiency, and interpersonal relationship through the occupational therapy.

There are the following courses to obtain the qualification for national examination for occupational therapists after graduating from high school; 1) study at the university occupational therapist training course for 4 years, 2) acquire the necessary knowledge and skills for at least 3 years at vocational schools designated by the Minister of Education, Culture, Sports, Science or Technology, or the training facility designated by the Minister of Health, Labor and Welfare, 3) graduate from equivalent school to have license of a foreign country and is certified by the Minister of Health, Labor and Welfare (Figure 3).

There are 70 universities, 4 junior colleges, and 106 vocational schools as training institutions qualified to national exam for occupational therapists.

#### 2-4. Clinical Engineer

Clinical engineer is a relatively new national qualification legalized in 1987 and the first national exam took effect in 1988. Clinical engineers are in charge of operation and maintenance, inspection, and management of life supporting equipment which temporarily substitutes for life sustaining human life functions such as breathing, blood circulation, and metabolism. Among medical teams, it is positioned as a specialist with engineering knowledge such as machinery and electronic equipment.

Every organ inside the body plays a variety of functions in order to maintain human life and keep it in a healthy state. When these living organisms' functions are deteriorated, life cannot be maintained. Medical devices are used temporarily to substitute or assist the functions of living organisms, such as during surgery of the heart. Medical devices that replace such living movements are referred to as life support management devices. Examples of life support management devices include artificial dialysis devices (blood purification devices), artificial heart-lung devices, artificial respiration devices, hyperbaric treatment devices, defibrillation devices, and extracorporeal cardiac pacemakers. The job of clinical engineers is to assist such therapy by manipulating such a life support management device and maintenance, inspection and management so that the medical device can always be effectively used safely and effectively. Currently, 26 thousand clinical engineering technicians are active in the whole country, but there is still a shortage of the



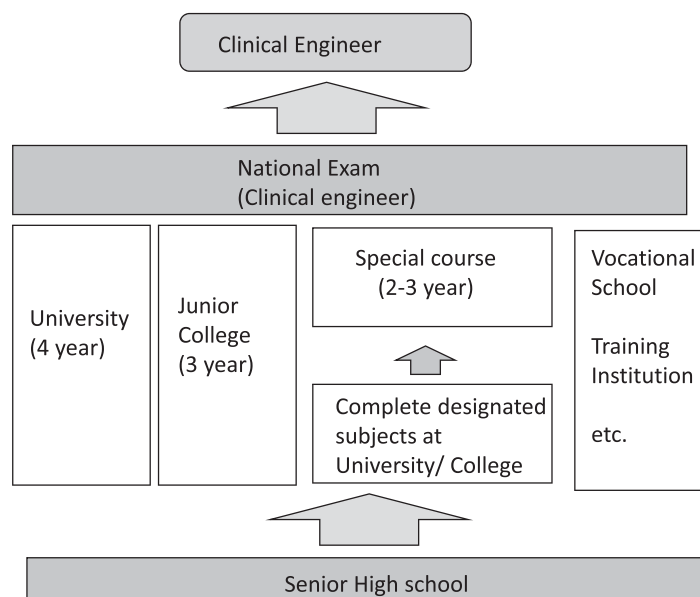


Fig. 4 Training courses for clinical engineer

professionals.

To be qualified to take clinical engineer national exam, 1) to learn subjects designated by the Minister of Health, Labor and Welfare at a university (4 years course), 2) to graduate from a junior college specified by the Ministry or a training school for at least 3 year (college of technical college). 3) to complete the required subjects at a university or college, and then finish the course for clinical engineers at a university, college of technical school specified by the Ministry of Health, Labor and Welfare (Figure 4).

There are 56 training facilities for clinical engineers nationwide, 26 universities and 30 specialized schools (training centers) and all are private schools. The term of study is 4 years of college, 3 years of junior college (junior college major, 1 year), 3 year training institute.

In the clinical engineer training facility, it is stipulated by the regulations to learn more than 93 credits of specialized knowledge and skills, the curriculum is divided into basic fields, basic specialized fields, and specialized fields. Lectures and practical training are organically combined. The job opportunity is open for clinical engineers in medical institutions such as hospitals using life support management equipment including hospital's operating room, artificial dialysis room, intensive care room, hyperbaric oxygen treatment room, and others.

### 3. Paramedical professional organization

Professionals make guilds. Then, while receiv-

Table 5 Medical and Healthcare Professionals in Working Place

Doctors <sup>1)</sup>	303,268
Pharmacists <sup>1)</sup>	280,052
Dentists <sup>1)</sup>	102,551
Nurses <sup>2)</sup>	1,103,913
Public health nurses <sup>2)</sup>	58,535
Assistant nurses <sup>2)</sup>	372,804
Midwives <sup>2)</sup>	36,395
Physical therapists (PT) <sup>3)</sup>	61,621
Occupational therapists (OT) <sup>3)</sup>	35,427
Orthoptists <sup>3)</sup>	6,819
Speech language hearing therapists <sup>3)</sup>	11,456
Orthotists <sup>3)</sup>	138
Clinical radiologic technologists <sup>3)</sup>	49,106
Medical technicians <sup>3)</sup>	62,459
Clinical engineers <sup>3)</sup>	20,001
Dental hygienists <sup>4)</sup>	108,123
Dental technicians <sup>4)</sup>	34,613
Massage and finger pressure therapists <sup>4)</sup>	109,309
Acupuncture therapists <sup>4)</sup>	100,881
Moxibustion therapists <sup>4)</sup>	99,118
Judo therapists <sup>4)</sup>	58,573
Emergency medical technicians <sup>5)</sup>	37,567

1) Source: "Survey of Physicians, Dentists and Pharmacists 2012", Statistics and Information Department, Minister's Secretariat, MHLW

2) Source: Health Policy Bureau, MHLW (2013)

3) Source: "Survey of Medical Institutions and Hospital Report 2011", Statistics and Information Department, Minister's Secretariat, MHLW\* Full-time equivalent numbers

4) Source: "Report on Public Health Administration and Services 2012", Statistics and Information Department, Minister's Secretariat, MHLW

5) Source: Health Policy Bureau, MHLW (as of December 31, 2009)

ing reviews from peers, each profession will raise its expertise. Nurses, physiotherapists, occupational therapists, clinical engineering technicians

are all important paramedical staff to provide medical services by experts. The so-called expertise of such experts of medical service knowledge and technology goes forward through information exchange and information sharing within each guild.

Professionals in medical and care service are professionally educated at universities/colleges or vocational schools and are recognized as having knowledge and skills to satisfy medical services by passing the national exams. Those professionals are under the umbrella of Japan Nursing Association, Japan Physical Therapy Association, Japan Occupational Therapy Association, or Japan Association of Clinical Engineers, respectively.

#### **4. How to implement research by paramedical professionals**

##### **4-1. Basic and clinical research in medical science**

Due to recent restrictions on medical expenses and the introduction of a new training system for medical school graduates, the research environment in medical science has drastically changed in Japan. Medical doctors' enrollment has been decreasing in basic medicine of graduate schools in these years. There are more researchers with PhD than physicians (MD) in many basic science departments of medical school. Even in clinical departments, clinicians are getting out of laboratory of the medical school as more young people are fascinated by specialist qualifications than acquiring PhD degrees. Such a change is beginning to influence the direction of medical research itself.

In the past two or three decades, basic medical research in Japan had been well development and major leading medical schools are now equipped with reasonably sufficient laboratory which is comparable in basic research laboratories of universities in Europe and the United States, producing excellent research results. The number of papers from Japan published in major scientific journals including Nature and Science also increased in these days. In this sense the research in basic medicine has reached a certain level.

On the other hand, how about clinical research? There are definitely few clinical research papers from Japan published in major journals such as Lancet or New England Journal of Medicine. The level of clinical research in Japan is by no means high enough compared with that in basic medical science.

What can be the possible reason of this gap between basic and clinical research in Japan? To carry out excellent clinical research, a lot of manpower, time and effort based on excellent design are essential. Excellent clinical research can never be done in a single clinical institution because enough number of clinical sample is usually required to produce clinically supported evidence.

Research in medical science can be broadly divided into basic research and clinical research. Clinical research may include 1) epidemiology and onset factors, 2) symptomatology, 3) clinical pathology, 4) relapse/relapse/long-term prognosis, 5) therapeutic intervention, 6) pharmacotherapy, 7) psychosocial intervention and psychological education, 9) side effects and complications, 10) prevention and early intervention. On the other hand, the basic research can be also classified: 1) genetics and genomics, 2) pathogenesis, 3) risk factors, 4) imaging/functional imaging, 5) physiological examination, 6) biochemical examination, 7) molecular pathological and pharmacological hypothesis, 9) drug and biomarker discovery, 10) development of new therapeutic methods, and others.

##### **4-2. Three stages of medical research**

Although the basic and clinical medical research are mutually influencing and progressing hand in hand, we can think of the developmental stage of medical science research in three stages. The first stage of research is "clinical research" that summarizes clinical experience, ingenuity, and knowledge. This type of clinical research is also a research that collects case reports or a series of several cases that have been experienced by a clinician, or accumulated cases by a group enough to withstand statistical evaluation leading to certain conclusions.

As a second stage, we will be engaged with basic research of the topics that have been selected and sorted out from the clinical experience and extracted as research subjects. In order to solve the scientific questions extracted from the clinical experience, we can rely on an experimental setting with other conditions artificially controlled, to lead to certain results through experiments. In modern medical science, basic research in genomics, cell biology, physiology, or pharmacology and other subspecialty of science can be experimented in a laboratory. However, the results of basic research at the second stage are worthless unless feedback to the clinical setting is planned by the next third stage clinical



study.

The third stage will be again the clinical research requiring much more expense, time, and efforts than the basic research in the second stage. Clinical research in the third stage may have more benefits and impact to clinical service than basic research. There may be wide difference in the quality and feasibility between the first stage and the third stage of clinical study.

The quality of clinical research is based on the controlled enough clinical data collected from a large number of well-designed samples, which requires enormous cost, labor and time. To establish such clinical research, a nationwide or global cooperative team should be organized for the goal of the clinical study. Such clinical research is hard to implement for clinicians in Japan. Thousands to tens of thousands of clinical data represented by the Cochrane Database are good example of the most valuable data in clinical medicine which can be utilized as the basis of evidence-based medicine (EBM)

#### **4-3. Research by paramedical professionals**

Studies by paramedical staff should start with clinical studies in the first stage as described above. In the first stage of clinical research, an idea of the clinician in charge of a patient is the most important. But the idea itself cannot be converted into scientific question to be studied as research project. It is required to rephrase clinical questions into scientific research topics to be aimed for the solution. For example, when a clinician in charge of a patient faces to clinical difficulty if something goes wrong, everyone wants to resolve the situation trying to think about the cause of the clinical problem. Then, the clinician with the problem will try to look for the solution by reading the literature, asking the advice from the senior colleagues who might know better in this particular question. Such intelligent endeavor and attitude is quite important for all paramedical professionals, which can be the start of clinical research. The start point of research oriented service is the eagerness to solve any clinical problems and questions, and all paramedical professionals are expected to do their best for the sake of the patient's advantage. In other words, do not leave the problems in clinical settings without trying to resolve the matter. At least, the paramedical professionals should try to seek for the solution how to resolve the question. However, in clinical situations, there are many problems that cannot be solved by itself. If you encounter such a scene, you should

summarize that subject as a case report.

Case reporting may be the first step in clinical research for all types of paramedical professionals. You will be conscious of the common problems as you repeat such experiences, then it is possible to extract problems common to multiple cases. When you come up to the specific scientific problem to be solved, please consider whether the common problem can be solved in the literature. If you do not come to the solution in the literature, you will understand the problem should be solved by yourself, and such problem consciousness will lead directly to the second stage of research in which you want to design experimental or survey research.

The most important thing in the second stage of experimental or survey research is its designing. It depends on the choice of the appropriate research theme whether it will be an excellent research paper with high quality or not. It may seem surprising to the young people, but this is an important point to keep in mind when you are to be engaged with any research works. In most of research facilities with a certain level, when the research theme has been decided after close examination and discussion, it is relatively easy to collect the data for that purpose if the research theme has been appropriately chosen for the laboratory in which the actual data can be almost automatically gathered. In other words, after the research theme is appropriately decided, the following process is relatively easy routine one for the laboratory, and time and labor will be spent for actual data collection. Basically, it is a procedure that follows a routine for the laboratory. For example, for the laboratory engaged with survey study, data collection will be carried out using the cohorts that are used in that laboratory. For the experimental study laboratory, laboratory equipment is already adjusted for the particular purpose, regardless of the mode of research, whether genetic, physiological, biochemical, or psychological and others. The work of data accumulation is carried out according to the experimental method available at the experimental facility. The process after the setting of the research theme is the routine work which is automatically carried out according to the facilities of the laboratory.

Considering such a situation, it is not an exaggeration to say that it is almost decided at the stage of research theme setting whether research is good or not. You should understand that it is the most important to fully examine what kind of experiment and survey can be done in your

laboratory after close discussion with the primary investigator who is responsible to the laboratory management. It is necessary to carefully consider whether or not you can do your research even under the research topics you propose in the laboratory you belong to. It is most important to thoroughly examine the feasibility of your research theme with the fellow and boss of the facility to which you belong. There is no doubt that the most important stage of the study by paramedical professionals is the setting of research theme.

#### **4-4. Research unique to paramedical professionals**

Humanity and individuality beyond EBM may be required for clinical research. Even the results derived by accumulating clinical data by tens of thousands of organs are not necessarily applicable to the value of one patient as it is. The point that paramedical professionals cherish is the fact that paramedical staff is facing with the patient as a whole human nature, and the human subjectivity must be further added to the combination of all the data from each organ. From this point of view, clinical research by paramedical professionals can be fully activated under the current medical education and training system. Paramedical professionals are facing the patients with the front line directly exposed with the human interaction with the patient.

## **5. Present Research Topics of Aino University**

Grant-in-Aid for scientific research (KAKENHI) from the Ministry of Education, Culture, Sports, Science, and Technology (MEXT) is the main financial resource of scientific research in most of universities and colleges in Japan. In 2015, Aino University set up the rule that all qualified teaching staff of the university should submit application for KAKENHI in order to increase the amount of research funding. It was the proposal by the authors to our colleagues to stimulate and promote research activity in Aino University. Aino staff successfully obtained 7 grants-in-aid (out of 55 applications) in 2016, and 8 grants (out of 58 applications) in 2017. Since most of research proposals are 2-3 year period, 21 research topics are currently investigated by Aino principal investigators. The list of research topics approved as Grant-in-Aid by government is cited in Table 6.

All research topics in Table 6 reflect unique and interesting research executed in nursing (NS), physiotherapy (PT), occupational therapy (OT), medical engineering (ME) department, and central laboratory (IN) of Aino University. It should be recognized that KAKENHI of Aino University increased significantly in recent years, which will surely promote the research activity further among paramedical staff in Aino University.

Table 6 Grant-in-Aid Scientific Research obtained by Principal Investigators of Aino University

	category (number)	name of PI	department	study period (year)	grant (JPY)	Research Topics
1	Scientific Research B (16H05379)	M. Takeda	AD	2016-2018	4,550,000	Mechanism of abnormal p@rotein deposition and neuro-degeneration in fronto-temporal lobar degeneration
2	Challenging Exploratory Research (26670944)	K. Kanda	NS	2014-2016	extended	Strategy and development of the program for clinical nurse planner
3	Scientific Research C (15K11536)	M. Takahashi	NS	2015-2017	1,820,000	System for supporting the professional identity of nursing students in Japan and Phillipines
4	Scientific Research C (15K11738)	Y. Saito	NS	2015-2017	1,040,000	Can early pregnant Na/K ration in urine predict and prevent perinatal hypertention?
5	Scientific Research C (16K12226)	Y. Honda	NS	2016-2018	260,000	Color using methods to prevent falls of the elderly dementia
6	Scientific Research C15K01675	M. Imamura	NS	2015-2017	650,000	Study of adequate daily life care of severely handicapped children observed from physiological parameters
7	Scientific Research C17K12194	K. Kanda	NS	2017-2019	1,040,000	Elusidation of essentials nursing quality-professionalism and professional motivation-
8	Scientific Research C17K12433	M. Sasatani	NS	2017-2019	1,300,000	Development and validation of the scale for practical nursing at special nursing home for the elderly
9	Scientific Research C17K12503	R. Hayakawa	NS	2017-2020	1,430,000	Study of traffic accidents byf visiting nurses during work
10	Scientific Research C (16K01746)	Y. Yamato	PT	2016-2018	650,000	Development of stretch exercise program aiming for the prevention and improvement of atherosclerosis
11	Scientific Research C17K02957	N. Matsuda	PT	2017-2019	1,300,000	Possibility and usefulness of TTS synthetic voice in foreign language learning
12	Scientific Research C (16K01527)	H. Sakai	OT	2016-2018	2,080,000	Changes in cerebral network activity according to the assigned task-mechanism underlying efficient learning environment-
13	Scientific Research C (16K11390)	C. Ide	OT	2016-2018	1,300,000	Stimulation of nerve regeneration of spinal injury by non-cell humoral factor
14	Young Scientist (B) (16K16582)	T. Hayashi	ME	2016-2018	1,170,000	Grasping the mental health condition by quantitative measurement of biological adaptive response to daily stress
15	Young Scientist (B) 16K21515	S. Kohri	ME	2016-2017	390,000	Quantitative evaluation of dynamic erythrocyte deformation by hemodialysis
16	Scientific Research C17K01381	H. Miyazaki	ME	2017-2019	2,470,000	Biomechanis of endothelial response to osmotic pressure load
17	Scientific Research C17K01597	A. Ikarashi	ME	2017-2019	1,430,000	Development of Stress evaluation system in daily life using non-touching IoT sensor module
18	Scientific Research C (15K10957)	N. Nakano	IN	2015-2017	1,690,000	Analysis of nerve regeneration by a factor derived from interstitial cells of bone marrow
19	Young Scientist B17K18266	K. Kanekiyo	IN	2017-2019	1,430,000	Elusidation of neuro-regeneration mechanism via choroid plexus
20	Scientific Research C (26460927)	N.Yamamoto	—	2014-2016	extended	Development of an innovastive blood glucose reducing model with closed-loop of the elderly diabetics.
21	Scientific Research C17K09362	K.Tanaka	—	2017-2019	2,340,000	Elusidation of mechanism of functional gastro-enteropathy due to stress and development of imaging biomarkers
				total amount	23,790,000	