Study on the mobile clinical laboratory system equipped with a clinical test apparatus

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Key Words

medical technology ／ mobile clinical laboratory ／ clinical examination ／ home medical care

Summary

The purpose of this study utilizes clinical examination, and it is to support each field of health and medical care and the welfare. In late years, the medical technology in the world is developing in the remarkable speed. The apparatus to use for a clinical examination has many kinds and diversification. Japanese advanced engineering includes mechanical engineering, photonics, communication engineering, environment, energy technology, nanotechnology. Those are used as a technique (e.g., separating analysis, image analysis, distant place data communication, compact apparatus, energy saving) of the medical domain widely. In the clinical examination domain, much medical equipment using these advanced technology is used. The result of the clinical examination is used for a diagnosis and effect of treatment. In addition, it is used for a prognostic judgment of illness, and the usefulness is high. Furthermore, the clinical examination has an important role for an index of the health. EBM (evidence - based medicine) is to express human condition (health and a disease) in numerical value and image data based on a result of the clinical examination. It is a scientific evaluation that health condition is judged by comparison between analysis value and standard value and using image processing diagnosis. The clinical examination judges whether the health care of own is carried out appropriately. Precision inspection and treatment are required at the big hospital such as a regional medicine support hospital and the university hospital when a disease is doubted. The construction of the medical system that it is easy to understand to people is the final act. We make mobile clinical laboratory and want to carry out collection of blood and sonography, an electrocardiogram, a respiratory function test. I report that I planned a model study of that purpose.

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1. Purpose

Now, the clinical examination is utilized widely for a diagnosis and treatment and follow-up, in the medical facilities such as a hospital and the medical office. In addition, it is important in examining grounds of the health in the field of examination. There are a laboratory determination and physiological examination when it classifies roughly in clinical examination.

Table 1 shows a laboratory determination and both main items of the physiological examination. The laboratory determination includes a biochemical test (protein, nonprotein nitride, saccharide, lipid, lipoprotein, electrolyte, various enzymes) or a hematologic test (CBC, coagulation study, blood type) bacteriological examination (the bacteria detection, separation, culture, identification). The physiological examination includes an electrocardiogram, a pulse wave, brain waves, sonography, a respiratory function test. The person receiving clinical examination must go to medical facilities basically. The construction of the system that clinical examination is received for people having difficulty in movement thinks with need today while home medical care advances.[1)]

Table 1 The kind of the clinical test

laboratory determination	Physiological examination
Biochemical Test	Electrocardiography
Hematologic test	Electro encephalography
Immunological test	Respiratory function test
Microbiologic examination	Sonography
Pathological examination	Electromyogram
General inspection etc.	Audiometry etc.

2. Contents

1) The clinical examination item which it should measure in mobil clinical laboratory

Figure 1 shows the cause of death of 2007 and 2008 in Japan.[2)] The cause of death that the total number of the annual death was 1,100,000 people and was the highest was approximately 340,000 people of the malignant neoplasm. Next much cause of death is heart trouble, cerebrovascular disorder, pneumonia and accidents. By the way, it is a big social problem in Japan that there are many suicides by an economic depression.

Table 2 is the list which watched the highest malignant neoplasm according to an organ for the cause of death in 2008 in Japan. The human body organ which was the highest for the cause of death is the trachea, the bronchus, the lungs. Stomach, liver, common bile duct, the bowels, pancreas are moderate.

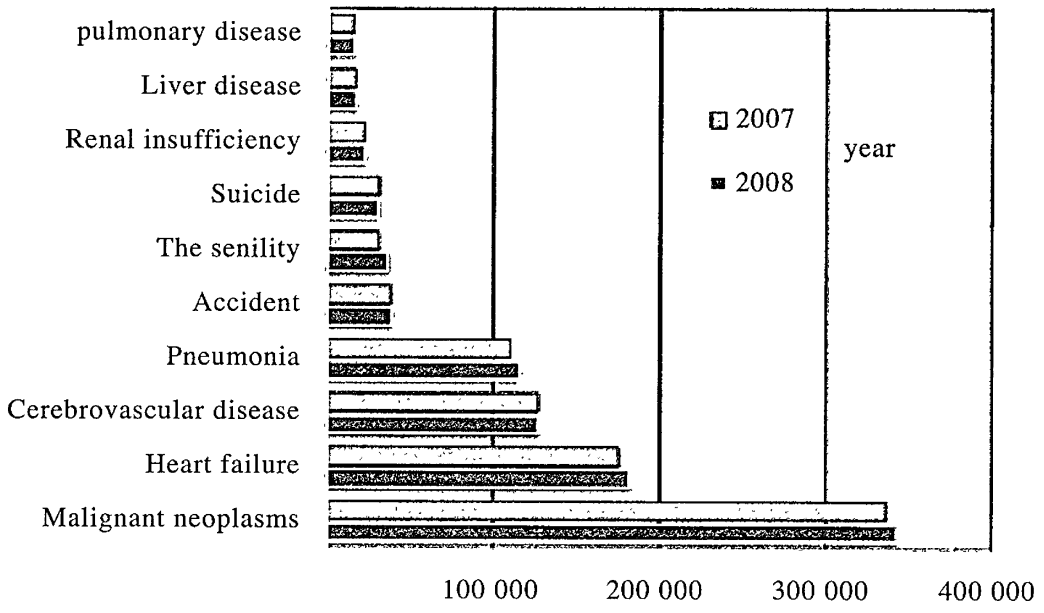

Figure 1 The cause of a person's death in Japan

Table 2 Statistical table In the year 2008

Higher internal organs distinction	The number of deaths		
	Total number	Man	Woman
Malignant neoplasms	**342 963**	**206 354**	**136 609**
Trachea, Bronchus, Lungs	66 849	48 610	18 239
Stomach	50 160	32 973	17 187
Liver, Intrahepatic bile duct	33 665	22 332	11 333
Colon	28 804	14 482	14 322
Pancreas	25 976	13 703	12 273
Others	23 645	13 191	10 454
Gall bladder, Bile duct	17 311	8 307	9 004
Rectosigmoid	14 207	8 937	5 270
Breast	11 890	93	11 797
Gullet	11 746	9 997	1 749
Prostate	9 989	9 989	*
Malignant lymphoma	9 399	5 332	4 067
Leukemia	7 675	4 554	3 121

Table 3 Choice of the clinical test item which we should measure in the mobile clinical laboratory

Biochemical tests	Hematologic tests	Physiological tests
TP,Alb,Cre.UN, UA T-Cho,HDL-Cho,TG BS Tumor maker (CEA,AFP, CA19-9,PSA)	Complete Blood Count	Sonography Spirometer
Various enzymes (GOT,GPT,LDH,ALP CPK etc) Electrolyte	Blood type	Electro-cardiogram

Table 3 shows the clinical examination item which we should measure in mobile clinical laboratory. The biochemical test is total protein or albumin including tumor marker. As for the hematologic test are Blood corpuscle analysis and a blood type, and the physiological examination are sonography, spirometer, electrocardiograms.

2) The investigation into apparatus and reagent which it should carry.

Figure 2 is a reference example of the devices which we should put on mobile clinical laboratory. The specifications of the biochemical analysis device are Fuji dry Kem 4000 (Fuji film Co., Ltd.). It doesn't use the water by the dry chemistry method. The analysis of 30 items is possible in this device. (colorimetric item 27, electrolyte 3) The hematologic device evaluates CBC with 60 automatic blood cell count device Pentra LC -5000 (Horiba, Ltd.). The ultrasonic

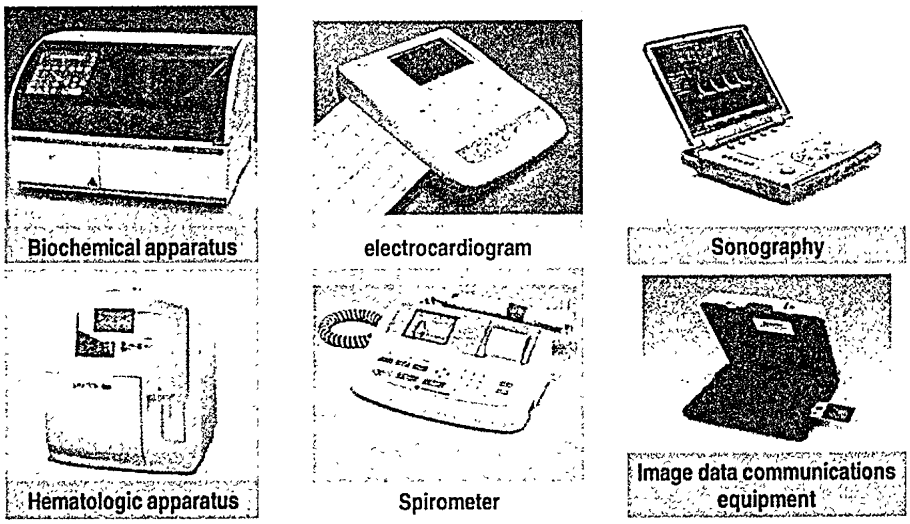

Figure 2 Investigation of the thing (an apparatus and a chemical reagent) which it should carry

diagnostic equipment (LOGIQe, GE healthcare Japan) can inspect, for example, heart, the abdomen, the carotid blood vessel. The electrocardiogram (ECG -1350, Nihon Kohden Co., Ltd.) inspects arrhythmia or a coronary heart disease with 6 channels and possesses the data analysis feature. The spirometer (microspiro HI -201, Nihon Kohden Co., Ltd.) inspects a respiratory function. There is image data communications equipment based on satellite communications. All these apparatuses can secure a power supply from the battery of the car. In the home medical care, charge of the inspection equipment is possible from a home power supply.

3) A main disease to be found in an inspection item of the mobil clinical laboratory

Figure 3 is a main disease to be found in an inspection item of the mobil clinical laboratory. It include a heart condition (arrhythmia, cardiac hypertrophy, valvular disease, a coronary heart disease), a respiratory disease (pulmonary embolism, respiratory failure), the disease (diabetes, a tumor) of the pancreas, a disease (a calculus, a tumor, the cirrhosis of the liver, fatty liver) of liver, the gallbladder, the disease (a calculus, a tumor, hydronephrosis, renal failure) of the kidney, a disease (having anemia, leukemia, infectious disease or not) of the blood, other diseases (an alimentary system tumor, breast cancer, prostate cancer, dehydration). There aren't views of illness by a result of the clinical examination, and good health is the most important.

4) The image of the mobile clinical laboratory.

Figure 4 is an image of the mobile clinical laboratory car. It uses the station wagon which is compact to use it on the site of the home medical care, and this can open a sphere of movement. Car in itself uses a thing of the energy saving, too, and the battery to carry uses a large-sized thing, and the charge of the inspection equipment can be finished during a run. The apparatus for physiological examination is carried in a house and is used directly. Therefore even a home power supply is equipped with the apparatus which can operate.

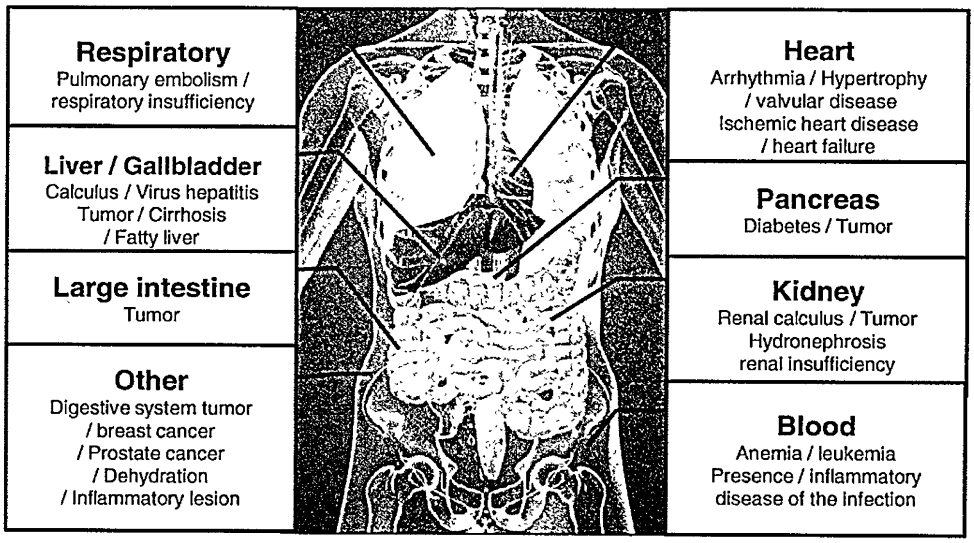

Figure 3 Detectable main disease

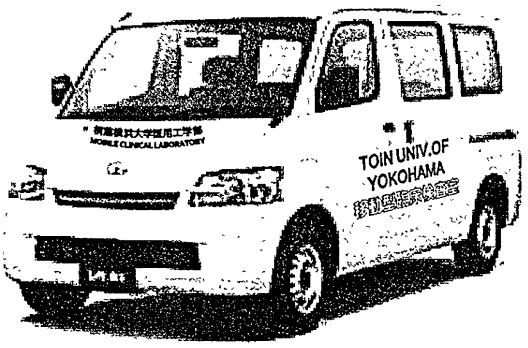

Figure 4 Image of the mobile clinical laboratory car

4. Problems of the study

Table 3 expressed the problems of this study.

- This study is still a planning phase.
- It becomes necessary for the inspection equipment to carry to decrease the watt consumption of vibration isolation and the device.
- The development of the image transmission technology from the distant place.
- Safety control of the personal information.
- The development of the data analysis program.
- Data preservation and the epidemiological use.
- The data communalization with the medical institution.

There are many problems with this study, but there is an expandability for the future.

5. Effect

In the area where a specialist is not of the diagnosis, it can contribute to correction of the medical regional disparity to build a mobile clinical laboratory system car. The clinical test data are transmitted to a diagnostician by radio. Even if a person receiving clinical examination with a diagnostician is a long distance, this is available. The infrastructure damages such as a blackout or the suspension of water supply occur when a disaster occurs. The mobile clinical laboratory can urgently support at the time of the disaster. In addition, this system is available in the area where infrastructure maintenance in developing countries is insufficient. I think this to be effective for an international contribution in medical care and health promotion.

References

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2) General condition of 2008 vital statistics (the number of the decisions), Ministry of Health, Labour and Welfare (2009)