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**(Citation)**

Bulletin of allied medical sciences Kobe : BAMS (Kobe), 12:179-185

**(Issue Date)**

1997-01-24

**(Resource Type)**

departmental bulletin paper

**(Version)**

Version of Record

**(URL)**

<https://hdl.handle.net/20.500.14094/00188155>



# Rescue Mission for Patients with Chronic Diseases such as Diabetes -The Design of the Mobile Laboratory-

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We formed a medical examination squad to achieve the early detection and prevention of the ingravescence of chronic disease. It comprised a total number of 267 individuals man-days including doctors, nurses, counsellors and volunteer workers. The main target was chronic diseases such as diabetes, hypertension, screening of heart, liver and kidney malfunction, and the nutritional state. We designed the mobile laboratory for the diagnosis of these chronic diseases. 15 items of clinical chemistry, 8 items of blood tests, 11 items of urinalyses, blood pressure, blood gas, ECG, chest X-ray were chosen. A dry chemical analyzer (Spotchem SP-4410) was used since this needed no water. It took 5-6 hours to complete the whole task from medical interview to the case analysis with 40-60 examinants. A reliable accuracy was accompanied by data measurement and the checking of the examination items. We found that the mobile laboratory was useful for the early detection and prevention of the ingravescence of chronic diseases in disaster area.

## Key Words

Mobile laboratory,  
Dry chemistry,  
Chronic disease.

## Introduction

The disaster relief care activities for the quake were met with good results, thanks to the dedicated activities of personnel concerned from administrative organizations and medical institutions. However, concurrent with the abovementioned success, the relief care activities revealed a number of lessons to be learned and problems to be solved for future crisis management. The co-medical field

was not an exception. Each section of the field was forced to struggle to provide the necessary services.

The collapse of precision laboratory instruments was fatal, since they are essential for the achievement of "human oriented" nursing services. In addition, we were faced with the reality that undamaged instruments did not work due to the cut in the supply of water and electricity. On the other hand, research undertaken by KASHCUS (Kobe Association of Strategies for Health Culture in Urban Settings) confirmed that patients who suffer chronic diseases are incapable of going for outpatient treatment, not mention for medical examinations due to the dramatic changes in the living environment, such as abnormal conditions in the transportation system and the medical supplies<sup>1)</sup>. A medical examination squad was formed in order

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Table 1. Details of Participants in the Medical Examination Squad

|                             | Total Number of Man-Days | Average Number of Man-Days | Total Participants |
|-----------------------------|--------------------------|----------------------------|--------------------|
| Doctors                     | 69                       | 11.5                       | 28*                |
| Nurses                      | 48                       | 8.0                        | 27**               |
| Medical Technologists       | 58                       | 9.7                        | 36                 |
| Radiographic Technologists  | 19                       | 3.2                        | 16                 |
| Clerical Assistants         | 31                       | 5.2                        | 23                 |
| Assistants from Bussinesses | 42                       | 7.0                        | 19                 |
| Total                       | 267                      | 44.6                       | 149                |

\* The Number includes 1 optometrist, 2 physicians and 3 doctors from Japan Doctors Association.

\*\* The number includes 8 nursing college students

to achieve the early detection and prevention of the ingravescence of chronic disease. It was formed in collaboration with Hyogo Association of Medical Technologist, manufactures of medical instruments and chemicals. It comprised a total number of 267 individuals man-days including doctors, nurses, counsellors and volunteer workers (Table 1). The squad patrolled 6 shelters where, under the direction of the squad doctors, 209 people were chosen to conduct medical interviews and the several clinical examinations.

In the present study, wa examined the design of the mobile laboratory in

disaster area and made the essential items of the clinical examination clear through the actual activity.

## Methods and results

The first step for the medical examination was the investigation of the necessary examinations and the selection of the instruments required for the chosen examinations. Consideration was given to chronic diseases such as diabetes, hypertension, screening of heart, liver and kidney malfunction, and the nutritional state. Thereafter, 15 items of examinations of clinical chemistry, 8 items of blood

Table 2. Instruments and Examination Items selected for the Moboile Laboratory

|                                                                                                     |        |
|-----------------------------------------------------------------------------------------------------|--------|
| <b>Automated Blood Chemical Analyzer; SPOTCHEM SP-4410</b>                                          | 5 sets |
| Glucose, AST, ALT, CK, LDH, T-Cholesterol, TG, Urea-N, Creatinine, T-Bilirubin, T-Protein, Albumine |        |
| <b>Automated Glycohemoglobin Analyzer; Hi-AUTO A<sub>1c</sub> HA-8121</b>                           | 1 set  |
| HbA <sub>1c</sub>                                                                                   |        |
| <b>Automated Urinalyser ; mini-AUTION ANALYZER &amp; CLINITEC 200 PLUS</b>                          | 2 sets |
| pH, Glucose, Protein, Ketone Body, Occult Blood, Urobilinogen, Bilirubin, Nitrous Acid, WBC         |        |
| <b>Automated Blood Cell Counter; Sysmex K-1000</b>                                                  | 1 set  |
| WBA, RBC, HGB, HCT, MCV, MCH, MCHC, PLT                                                             |        |
| <b>Others</b>                                                                                       |        |
| Automated Sphygmomanometer; GP-303                                                                  | 2 sets |
| Saturated Oxygen Ratio Counter; PULS OXY METER 511                                                  | 1 set  |
| Glucose Analyzer(Symplified Operation Type)                                                         | 5 sets |
| Centrifuger; CF-9510                                                                                | 3 sets |
| Electrocardiograph Bus                                                                              | 1 set  |
| X-ray Examination Bus                                                                               | 1 set  |

tests, 11 items of urinalyses and a blood pressure test were chosen (Table 2). HbA<sub>1c</sub>, CRP and SaO<sub>2</sub> (Saturated oxygen ratio) were also chosen as additional examinations. Laboratory instruments selected were all lightweight and portable. They were system-designed around the main instruments, Some dry chemistry instruments (SPOTCHEM SP-4410<sup>2)</sup>, Hi-AUTO A<sub>1c</sub> HA-8121<sup>3)</sup> and mini-AUTION ANALYZER<sup>4)</sup>) which is easy to install and take out and furthermore has no need of water. An electrocardiogram and a chest X-ray examination were conducted on indicated examinants for a further diagnosis of cardio-respiratory disorders such as pneumonia. Because an examination room had to be located in one of the rarely vacant classrooms in a makeshift school shelter, there were

restrictions on space, lighting and the supply of electricity. However, the first priority was given to the circulation of the examinants when locating the instruments (Fig. 1). The electrogram and X-ray examinations were conducted in a mass examination bus parked either on the school playground or a vacant block closest to the examination room. This bus also supplied electricity to the examination instruments installed outside as well as the electrocardiogram bus. Urine sampling and urinalyses were conducted in the washroom. Electrocardiogram and chest X-ray examinations were conducted in the outside bus.

There were no particular problems concerning the flow of patients from reception through to blood pressure tests, medical interviews and blood collection. However, because the ex-

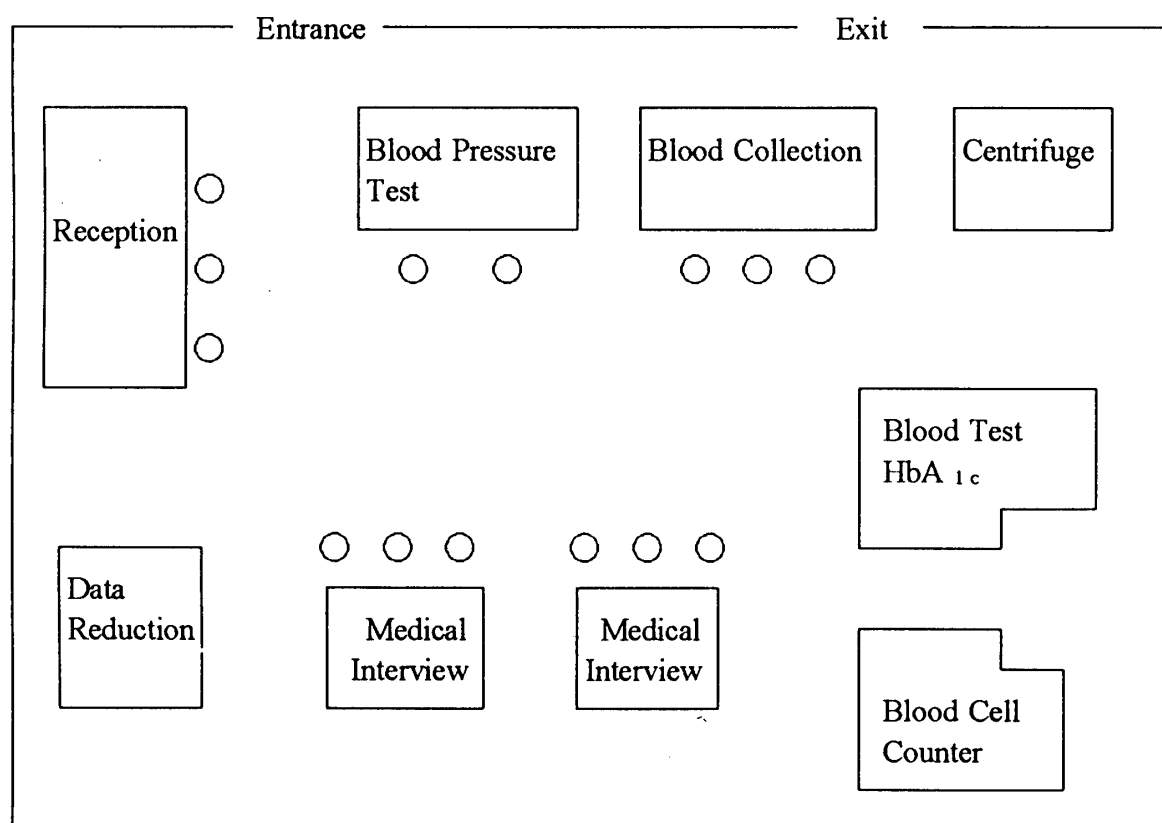


Figure 1. Structure and Layout of an Examination Room

amination room was small and excessively noisy, an unexpectedly long time was occasionally needed for reception and medical interviews, both of which required conversation with the examinants. Hence, there was a need for the appropriate relocation of staff and repositioning of the interviewing doctors. A blood sample of 3.5ml was collected from each examinant. A portion of 3ml was injected into a blood collecting tube containing EDTA-2K for blood tests and HbA<sub>1c</sub>. A portion of 0.5ml was injected into a micro blood analysis tube for clinical tests and CRP. Following the abovementioned process, the blood samples were centrifuged to obtain

serum which were used as samples for the Spotchem analyzer. Urinalyses were conducted in the washroom or in the corridors of the shelter. Some shelters had only temporary washrooms compelling the urinalyses to be conducted outside in the bleak cold. The control of the quality of data is essential no matter what the conditions are. The parallel usage of identical instruments were inevitable because the mobile laboratory had to operate under such merciless conditions and there were time restrictions in data production. Therefore, from the point of view of data reliability, it is important to manage the variation among instruments to minimum. Re-

producibility of 5 Spotchems and one blood cell counter was examined through simultaneous measurement by using control serum and examinant's blood as samples. As is shown in Table 3, the deviation among 5 Spotchem analyzers in both the normal and the abnormal range indicated a coefficient of variation of less than 5% in 9 items out of 15 with dispersion noticed in CPK, LDH and creatinine whose average figures are small. In this way it was assured that the producibility of 5 Spotchems are reliable along with the blood cell counter.

#### Allocation of time and staff for examinations

Medical examinations were started at 10:00am and took approximately 2 hours. It was scheduled that all the data, including electrocardiograms and the development of X-ray films, be ready an hour after examinations were completed. To make this schedule feasible, a group in charge of handling the instruments had to arrive at the examination site at 8:30am and complete all the preparation from the installation of the instruments to the test run. Therefore, they had to consider the traffic conditions at the time in order to accomplish their task. After the examinations ended at 1:00pm, meeting was held among the staff, the aid squad doctors and the members from the local doctor's association, where assessment of the examnants took place and remedies for each of them were decided (Fig. 2). All the examination data produced was offered to the local doctors as well as the relief squad. On average, it was just after 3:00pm when the squad dispersed following the clean

up of the room and the disposal of the medical waste.

## Discussion

The mobile laboratory was tried out at 6 shelters this time. This pilot program achieved a greater success than expected. We think that there was a desperate need for the mobile operation, when medical institutions had few instruments in working condition. This is true especially when the general situations after the tragedy hindered people who suffer chronic diseases from visiting the hospitals or the temporary medical posts for treatment.

Examinations for the precise diagnosis and data which serve as indexes are needed for the treatment of chronic diseases (such as diabetes, myocardial infraction, pneumonia, nephritis, hepatitis, anemia, hematemesis, asthma, rheumatism, etc). Thus many examination items were set up before commencing the mobile examinations. The patrol started in Nagata ward one month after the quake and the following points became apparent.

- (1) It took, on average, 5-6 hours to complete the whole task from medical interview to the case analysis with 40-60 examnants.
- (2) The net time each examnant spent was 2 hours.
- (3) A reliable accuracy was accompanied by data measurement and the checking of the examination items. They seemed to be able to copy with a 20 bed class examination facility on a daily examination basis.
- (4) It turned out to be effective to

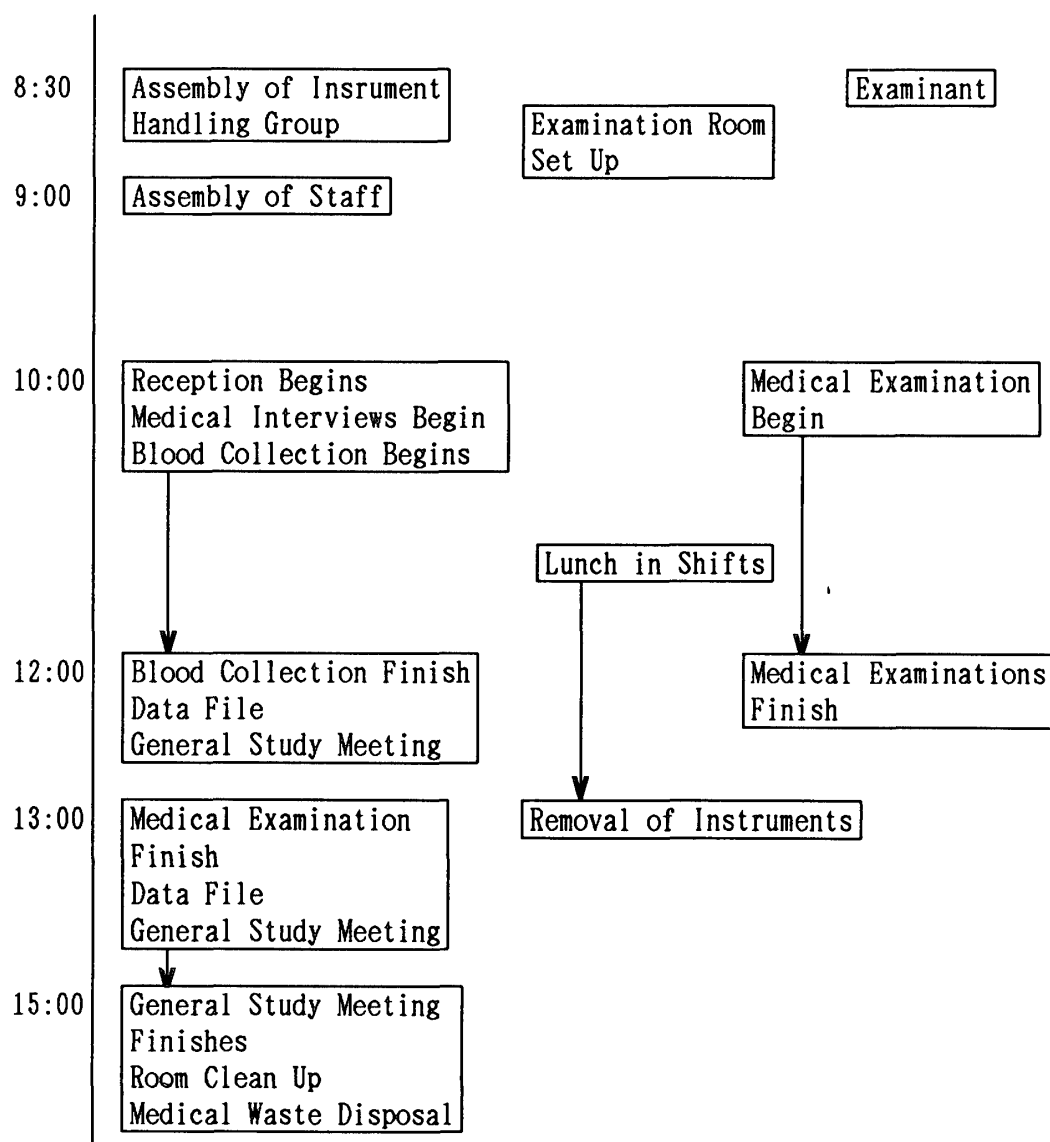


Figure 2. Description of Time and Work Allocation

conduct electrocardiograms and chest X-rays which were chosen as additional examinations, CRP for infectious diseases, and  $\text{SaO}_2$  (saturated oxygen ratio) for respiratory diseases such as asthma. The small number of cases detected through the above examinations were significant.

The reasons for the above-expected success are owing to the following. First of all there has been technological progress in analytical instruments, especially in dry chemistry based on solid phase analysis rather than liquid phase analysis, in the usage of lightweight small sized analytical instruments with built-in microp-

rocessors, and also in manpower. The medical squad had a total number of 149 individuals with each operation requiring 45 participants including doctors from different fields, students, volunteers from manufactures of medical instruments and pharmaceutical supplies.

Participants had not met each other and basically no preliminary arrangements were made prior to each operation. However, they cooperated in harmony with each other and accomplished their own task as if it were in the ordinary course of events. Flexibility could be seen when examinants were guided to the X-ray examination bus by doctors or nurses who had finished with their medical interviews. Another important requirement is the need for "the authorized coordinator" who has the power to design and practice medical examinations of this kind. When the significance of the

above mentioned medical examinations is considered, it is obvious that more examinations should have been conducted. More examinations would have become feasible if they had commenced at an early stage of the relief care and/or if they were accompanied by night shifts. The existence of multiple medical squads would also be essential.

### Acknowledgements

We hereby would like to express our gratitude for all those concerned, who supported us through this operation. These include citizen volunteers, manufactures of medical instruments and pharmaceutical supplies and personnel from legislative organizations. We would also like to express our sincere condolences to the 5500-odd people who were killed in the earthquake.

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