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Determining the Field Hospital Setting in Earthquake: Using RAND/UCLA Appropriateness Method

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Abstract

Background: Dispatching field hospitals meeting the needs of the sufferers is the ideal response to disasters such as earthquakes. The aim of this study is determining the settings of such a field hospital.

Methods: A twelve-member expert panel selected used the RAND Appropriateness Methodology to rate scenarios derived from best current evidence, and additional comments resulted from Nominal Group and Modified-Delphi Techniques. A 9-point rating scale was used that permits the categorization of the items as appropriate, uncertain, or inappropriate. A descriptive analysis was undertaken of the final results of the panel meeting.

Results: Of extracted evidence categorised as items in six chapters, 72.90% was considered appropriate, 15.89% uncertain and 11.21% inappropriate. In the first round, agreement was found for 87.06% of the 85 items. Following discussion on divergent ratings, much higher agreement was achieved, reaching 93.46% of the 107 final items.

Conclusion: Using RAND/UCLA Appropriateness Method, on the basis of the best current evidence, an expert panel assessed the items of Principal Tasks of Field Hospital, Staffing pattern and equipment as sufficient and appropriate in a multidisciplinary field hospital, developing updated and clear recommendations for rapid access to the setting of the field hospital in earthquakes.

Keywords: Hospital; Earthquake; RAND/UCLA Appropriateness Method; Trauma

Introduction

Natural and complex disasters such as earthquakes can cause a dramatic increase in the demand for emergency medical care.[1] As a matter of fact, this emergency care is a critical determinant for survival in the initial stages of a disaster.[2] Local health services can be overwhelmed, and damage to the health care infrastructure–as observed in Bam Earthquake will further compromise the delivery of health services.[3] As a consequence, affected and collaborating countries are anxious to find ways to provide immediate medical care to victims. An obvious solution would seem to be the dispatch of mobile field hospitals to the stricken area.[1,4,5] A field hospital is defined as a mobile, self-contained, self-sufficient health care facility capable of rapid deployment and expansion or contraction to meet immediate emergency requirements for a specified period of time.[1] The important point to be kept in mind is that the setting of the field hospital sent to the affected area should comply with the needs of the victims.[6] In addition, priority public health interventions designed to ensure that the greatest health benefit is provided to the greatest number of people should be based on the principle of evidence-based practice; those with a demonstrated public health benefit are preferred.[2] Unfortunately, the amount of valid practical evidence about the field hospital setting is limited; therefore, some methods are required for standardization of current practice and reduction of the gap between the current and ideal situations. Consensus panel methods provide a quantitative approach to issues in which there is

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uncertainty, controversy, or limited evidence.[7-10] They have been used to develop clinical guidelines,[10-12] appropriateness criteria,[13,14] quality indicators[15] and review criteria.[16] The two most commonly used methods are the Delphi Technique and the Nominal Group Technique.[8,9,17] Additionally, the RAND/UCLA Appropriateness Method[18] has been described as the "only systematic and meticulous consensus panel method for combining expert opinion and evidence".[19,20] The RAND/UCLA Appropriateness Method (RAM) which was developed in the mid-1980s, as part of the RAND Corporation/University of California Los Angeles (UCLA) Health Services Utilisation Study,[18] has been used to evaluate the appropriateness of a variety of medical and surgical interventions.[21,25] In general, it quantitatively assesses the expert judgment of a multidisciplinary group of medical professionals concerning a comprehensive series of medical scenarios on an appropriateness scale ranging from 1 to 9. It is iterative, with two rounds of anonymous ratings and a face-to-face group discussion between rounds. Each panellist has equal weight in determining the final result, an explicit appropriateness rating for focused issues.[18,26] For the first time, we used The RAND/UCLA Appropriateness Method in combination with Modified Delphi and Nominal Group Techniques for determining the field hospital setting in earthquakes according to the local circumstances. This study was undertaken to provide an updated document extracted from the best current evidence, combined with the expert opinion. The principal tasks of the field hospital, staffing pattern, and equipment with their subtitles are discussed in detail.

Materials and Methods

We used a combination of three techniques for determining the field hospital setting in earthquake: The RAND/UCLA appropriateness method, The Nominal group technique and Modified Delphi technique.[17,18] First of all, an extensive literature review was performed to find the best current evidence about the major affected groups in earthquakes, types of injuries, medical assistance in field hospitals prepared for earthquakes and field hospital settings. The extracted evidence summarized from the critically appraised literature and the lists of the various scenarios in the field hospital were prepared. These items were grouped into six "chapters" based on the principal tasks of the field hospital, being subdivided into "surgery & trauma management", "Obstetrics & Gynaecology", "Medical Care", "Outpatient Department and Dental Services", and staffing pattern and equipment. We actively sought people with diverse backgrounds from wide-ranging professions and organisations participating in medical assistance during the disasters for the project. Selection criteria for participants were 1) activity in a wide variety of medical services in disasters, 2) recognition as leaders in their field, and 3) willingness to collaborate. We sent the selected panellists a letter inviting them to participate. To maximize interaction, the number of participants in the meeting was limited, so we invited 18 experts for the panel meetings and finally 12 invitees participated actively in the project (n=12). A code was devoted to each invited panellist (p1 to p18) for further analyses. Our final panellists were a general surgeon, a paediatric surgeon with great experience in disaster and emergency medicine, an orthopaedic surgeon, an anaesthesiologist, a nephrologist, a paediatrician, a gynaecologist, two general practitioners nominated by red-cross/red crescent society, a specialist doctor in community-medicine, experienced in emergency medicine, a general nurse and a general technician. Many other professionals from diverse specialities were also invited as guests to the sessions for their invaluable clarifications about the various issues discussed in this project. We performed the process in three parts. Firstly in the "Zero round", we described our purpose comprehensively and also asked the main stakeholders to reach the consensus about the key subjects such as the format of the field hospital, the capacity, the funding and the executive responsibilities by nominal group technique. The literature review and the list of items, together with a list of definitions for all terms used in the list, were sent to the panel members. Each subject was rated on an appropriateness scale of 1 to 9, where 1 means that the focus item is extremely inappropriate for the field hospital setting, and 9 means that the item is extremely appropriate. A middle rating of 5 can mean that the aptness is uncertain. Each item was considered appropriate if the panel's median rating was 7–9 without disagreement, inappropriate if the value was 1–3 without disagreement, or uncertain if the median rating was 4–6 or if the members of the panel disagreed (see Figure 1.

According to the method of the BIOMED Concerted Action on Appropriateness, for panel size of 12 (n=12), "Disagreement" was defined as 4 or more panellists' rating in each extremity (i.e. 1-3 or 7-9) and "Agreement" as less than 3 panellists' rating

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Two elements of panel "median rating" and "disagreement" were combined to determine appropriateness categories of the different items (for definition of disagreement, see text).

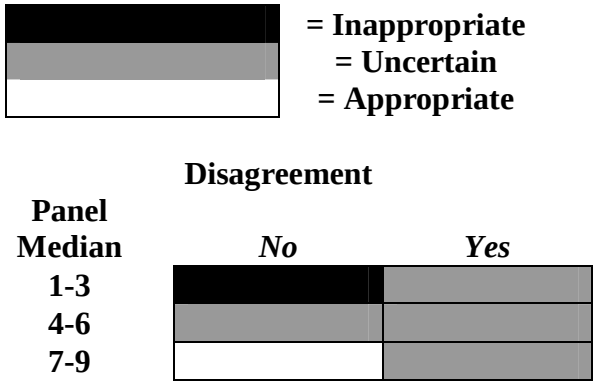

Figure 1: Appropriateness categories.

outside the 3-point region (i.e. 1-3 or 4-6 or 7-9) containing the median.[18] At the end of each chapter of the questionnaire, we added a "comments page" and asked the members to point out to the issues which they thought were required in a field hospital but not mentioned in our list. The panellists firstly rated the appropriateness of each scenario independently and returned their rating forms by mail. The ratings were then tabulated before the face-to-face panel meeting. We also consolidated the ideas from the comments pages according to the modified Delphi process and referred to the group for the second rating in the next session. In the second round, panellists received feedback on every item. Each panellist received an individualised document with his/her own previous rating score. During the meeting, we displayed each item by power point presentation, showing the frequency distribution of all the experts' first round scores (scale, 1-9), anonymously, and the median rating score. For each item the panellists discussed the ratings, focusing on areas of disagreement, providing the opportunity to modify the original list of issues, if desired. After discussing each chapter of the list of items, they re-rated each item individually. This method did not attempt to force panellists to reach agreement on appropriateness. At the end of each chapter in addition to rating the items added after the first session, the panellists were asked to express their suggestions in a nominal group technique for producing new items required in setting of the field hospital. Finally, the panellists rated the newly-added items in the "comments rating sheet", the items being analysed separately.

During the first round, each panellist rated 85 and during the second round 107 items due to newly-added items. According to RAND/UCLA Appropriateness Method, the results of the first round had no effect on the end product of the study[18], so there was more emphasis on the results of the second round. At last, we analysed the second round ratings as well as the newly-added issues ranked in the "comments rating sheet". The appropriateness of each item was calculated according to the method of the BIOMED Concerted Action on Appropriateness, as mentioned above. All of the statistical analyses of the first and second rounds were performed using SPSS for Windows version 11.0.

Results

The results are presented in two parts: literature review results and study results.

Literature Review Results: Affected groups in earthquake

According to the previous studies, the census showed a predominance of women, children, and young adults, with the average age being 28 years as the major affected groups.[27] More than 25% of patients requiring hospitalisation were children, of whom over 20% needed surgery.[28] In Marmara Earthquake, of 151 injured patients hospitalised due to musculoskeletal trauma, 31 (20.5%) were under 16 years of age.[29] In the Chi-Chi Earthquake in Taiwan,

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the results implied that *fragile minorities*, specifically the elderly and children, required special consideration and attention in regard to disaster rescue and emergency medical care allocation.[30] In Bam earthquake, according to reports from the State Welfare Organisation, 1800 children lost both their parents and at least another 5000 children lost a parent. Other children were also severely traumatized. Therefore, providing care and protection of children deprived of primary care-givers was a challenging issue. Underlying geographic and socio-economic conditions in the region of Bam might expose local women and girls to an even greater degree of physical and psychological harm. Providing care and rehabilitation for these women and girls, therefore, necessitated special efforts.[31]

Types of injuries in earthquake

The major problems of patients in earthquakes -as we saw in Marmara -were extremity trauma, crush syndrome, acute renal failure and other ensuing medical complications. The major associated injuries were in the lower extremities, upper extremities, and chest, respectively.[32,33] Although the types of injuries resulting from the earthquake were similar in adults and children, the orthopaedic consequences of these injuries showed significant variability, especially in the rates of crush syndrome leading to acute renal failure and amputation, being discussed in more details in the next section.[29,32] Analysis of 2,702 traumatised patients in the 1995 Hanshin-Awaji earthquake showed that crush syndrome and injuries to vital organs were potentially life-threatening, and early transportation of such patients to undamaged hospitals with the ability to provide intensive care would have improved the survival rate.[34] The important and severe medical complications in crush syndrome patients such as dehydration, oliguria, hyperkalaemia, etc. should always be anticipated.[32] The studies on chest trauma imply that approximately 10 per cent of the casualties of a great earthquake may be expected to have thorax and lung injuries mostly caused by blunt trauma, pneumothorax and rib fractures being the two most frequent pathologies, respectively.[35-37] In the Chi-Chi Earthquake in Taiwan, 30 per cent of the victims died from head injuries caused by the collapse of dwellings.[30] An experience from the IDF field hospital in Duzce, Turkey, showed that the circumstances of evening earthquake and non-industrialized area indicated a new post-earthquake burn syndrome, multiple scale burns due to hot liquid spills.[38] Also the prevalence of infectious diseases often has an incremental pattern in the period after the earthquake. For instance, in Bam earthquake, upper respiratory tract infections were the most common problem; 792 cases occurred 3 weeks after the earthquake due to the freezing weather, particularly at night.[39,40] Animal bites are also considerable in the affected area.[39,41] As seen in many disasters, for example in Spitak earthquake in Armenia or Bam earthquake in Iran, after exposure to severe trauma, adults were at high risk of developing severe and chronic post-traumatic stress reactions that are associated with chronic anxiety and depressive reactions.[31,39,42]

Medical assistance and hospital setting in earthquakes

In Marmara earthquake, 18.5% of children with crush syndrome required haemodialysis because of acute renal failure and 11.1% required amputation. In contrast, haemodialysis was needed in 93.1% of adult patients with crush syndrome, and amputation was necessary in 20.7% of them, implying a sound higher rate of haemodialysis among adults.[29] The most important and fatal medical complication in crush syndrome patients was hyperkalaemia, early detection and treatment of which improved the final outcome of renal disaster victims to a great extent.[43] Crush syndrome and injuries to vital organs are potentially life-threatening. Early transportation of such patients to field hospitals with the ability to provide intensive care will improve the survival rate.[32,34] In a retrospective study on Crush syndrome patients after the Marmara earthquake, the medical interventions performed according to their frequency were haemodialysis/haemoperfusion, mechanical ventilation, fasciotomy, amputation, ICU-care for adult respiratory distress syndrome as well as multiple organ failure and sepsis. Management of hyperkalaemia and oliguria was also important.[32,33] The field hospitals commonly face paediatric surgical emergencies in the affected area since approximately one quarter of patients requiring hospitalisation in Gujarat Earthquake, for instance, were children, of whom greater than 20% needed surgery. The operations fell into four categories of orthopaedics, soft tissue injuries, burns, and miscellaneous. There was an immediate need for orthopaedic and general surgery skills followed by a delayed need for plastic surgery skills.[28] In the management of post-earthquake burn syndrome, it seems that most of the patients could be treated successfully as outpatients with close follow up.[38] In Adapazari Earthquake in Turkey, Medical and surgical services

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in the settled field hospital were supplied by general, orthopaedic, and plastic surgeons. The frequency distribution of the medical problems seen in the field hospital was 32% internal medicine, 13% general surgery including plastic, 21% orthopaedic surgery, 23% paediatric disease, 10% obstetrics and gynaecology and 1% major psychiatric disorders. 11.4% of the patients treated by the field hospital sought aid for isolated soft-tissue injuries, 76% of which were earthquake-related. Plastic surgery patients occupied 13.6% of the hospital beds.[44,45] The mentioned field hospital provided advanced surgical and medical facilities including laparotomy, caesarean section, and intensive care surveillance by a team consisting of 102 personnel. These facilities required sophisticated laboratory and imaging services, including haematology, chemistry, microbiology, blood bank, and radiology and ultrasound.[44,46] After exposure to severe trauma whether an earthquake or violence, adults are at high risk of developing severe and chronic post-traumatic stress reactions that are associated with chronic anxiety and depressive reactions. Clinical evaluation and therapeutic interventions should include specific attention to these reactions. Early mental health interventions seem to prevent their chronicity.[42]

Study Results

In this study, 18 experts were invited for the panel meetings and finally 12 invitees agreed to participate actively in the project (66.67%). The panellists rated 85 items at the first round, and 22 items (20.56% of items in the final ratings) were added for the second round derived from nominal group and modified Delphi techniques. After the second round, 72.90% of the 107 scenarios were considered appropriate, 15.89% uncertain and 11.21% inappropriate. 93.46% of the items were rated without disagreement, 66.36% of which were rated with agreement and 27.10% were indeterminate (i.e. there were neither agreement nor disagreement), and the panellists had disagreement on 6.54% of the items. Six chapters of the items were analysed in the second round including Surgery and trauma management; Obstetrics and Gynaecology; Medical Care; Outpatient Department and Dental Services; Staffing pattern; and Equipments.

Table 1 gives a summary of agreement for all 107 scenarios evaluated by the experts.

Most of the comments developed from nominal group and modified Delphi techniques were added to chapter 6 (54.55% of total comments). No panellist rated outside the 3-point region containing the median in 23.36% of final issues with medians in the range of 7-9, which shows total agreement on the mentioned items as well as emphasis on the importance of these items.

Effect of multi-disciplinary discussion on agreement: An actual comparison between the first and second round rating of *appropriateness* was difficult to perform because the content of the scenarios rated was not exactly the same between the two rounds. However, the differences between the rounds are shown in Figure 2.

However, the impact of the panellists' interaction with other specialists can at least partially be analysed by looking at the differential agreement between the two rounds; in the first round, agreement was found for 87.06% of the 85 scenarios. The second round rating, following discussion of divergent ratings, resulted in a much higher agreement among panellists, reaching 93.46% of the 107 scenarios. This comparison is shown in Figure 3.

Table 1: Percentage of appropriateness and agreement categories by chapter

Title of chapter (No. of items)	Appropriate	Uncertain	Inappropriate	Disagreement	Agreement	Indeterminate
Surgery & trauma management (10)	60	20	20	0	60	40
Obstetrics & Gynaecology (5)	100	0	0	0	60	40
Medical Care (6)	83.33	0	16.67	0	33.37	65.67
Outpatient department & Dental services (6)	16.67	50	33.33	50	16.67	33.33
Staffing Pattern (30)	80	6.67	13.33	6.67	70	23.33
Equipments (50)	74	20	6	1	75	20
Total (107)	72.90	15.89	11.21	6.54	66.36	27.10

(For definitions, see Methods.)

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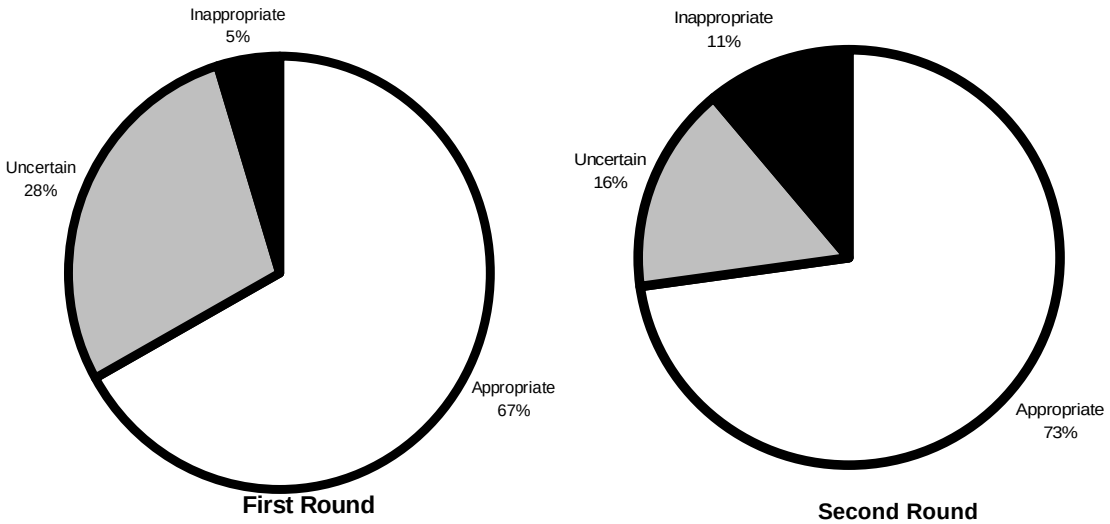

Figure 2: Comparison of appropriateness categories between the two rounds.

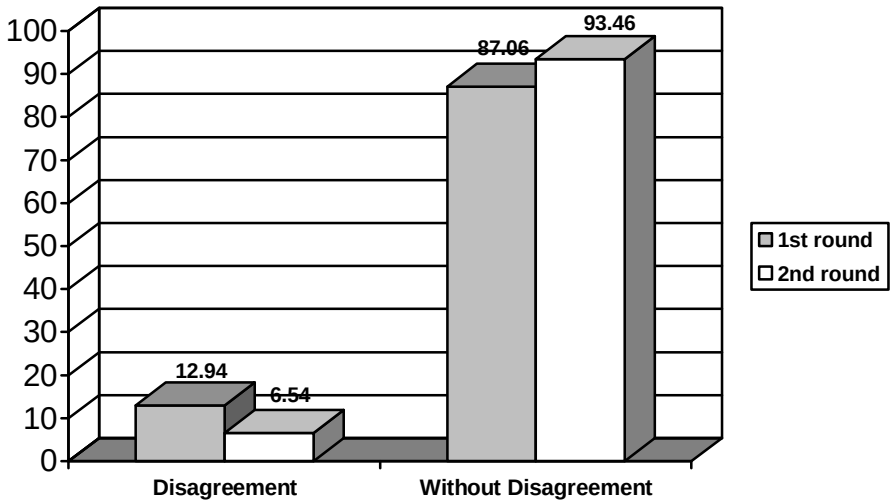

Figure 3: Comparison of agreement and disagreement between the two rounds

Discussion

The field hospital is designed for admission, classification and temporary hospitalisation of the injured patients (in the emergency phase).[47] It must be capable to provide advanced medical and surgical treatment, observation, tracking and recovery.[48] In this article, we have included updated and clear recommendations for rapid access of the reader to the setting of the field hospital on earthquakes derived from the best current evidence in conjunction with expert opinion, using RAND/UCLA Appropriateness method.

I Principal Tasks of Field Hospital: 1) Surgery and Trauma Management

The staff arrangement and equipment of the hospital should make it possible to perform major surgeries of the limbs, abdomen and thorax, as well as paediatric surgery and head & neck surgery (management of facial trauma).[46,49] The appropriateness of neurosur-

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gery and urogenital surgery is uncertain and plastic surgery was considered inappropriate by the panel.

2) Obstetrics and Gynaecology

The field hospital should be capable of performing emergency deliveries, caesarean section, and management of post-partum and abortion complications.[44,46] The experts recommend that the labour room should be separated from the surgical theatre.

3) Medical Care

The field hospital should be capable of performing the management of crush syndrome and its complications (e.g. hyperkalaemia, rhabdomyolysis, oliguria, etc).[29,32,34,50] Mechanical ventilation and ICU-care for adult respiratory distress syndrome as well as multiple organ failure, sepsis and other medical emergencies should be considered.[32,33] According to expert consensus, the management of acute ischemic heart disease and diabetic emergencies should also be addressed. There is uncertainty about performing haemodialysis/haemoperfusion in the field hospital.

4) Outpatient services

Outpatient management of burns (e.g. post-earthquake burn syndrome) is required.[38] Outpatient dentistry services needed to be done by a dentist are considered inappropriate but dental extraction should be addressed whenever necessary. There is uncertainty whether the triage /registration as well as outpatient services should be done in the outpatient department or not.[51]

II. Staffing Pattern:

A multi-disciplinary field hospital should include various health professionals as follows:

Medical specialists

General surgeon, Orthopaedic surgeon, Anaesthesiologist, Specialist in Internal Medicine, Gynaecologist and obstetrician, Paediatrician, Nephrologist, Radiologist and Sonographist, General Practitioner

Paramedical staff

Head Nurse, Ward Nurse, Operating Theatre Nurse, Midwife Nurse, Pharmacist Nurse, Hygiene/sanitation experts, Medical records and documentation expert.[1,6,28,45,46,51,52,53]

Hospital Administrator

Technicians

General Technicians, Laboratory Technician, Radiology Technician[51] and CSR technician.

Other personnel

Servants and Hospital Guards.

The presence of mental health experts and epidemiologists in the field hospital has uncertain appropriateness. Plastic surgeon, mother and child health specialist nurse and ENT/Head & neck surgeon and urologist are considered inappropriate in the field hospital by the expert panel.

III. Equipment

The equipment[1,28,32,33,44-46,52-56] are categorised into 6 main parts, which are presented in Figure 4 in details. The presence of Bacteriology, Serodiagnostic and Faecal parasite modules are considered inappropriate for the laboratory setting. The appropriateness of water testing module is uncertain. Portable CT-Scan Module is considered as inappropriate and Portable Colour Doppler Module as uncertain for the field hospital setting. Dental Unit, Dental Instruments and Portable Dental X-ray Modules are rated as inappropriate by the panel members. Skin-Graft Instrument Module, Auto-transfusion Instrument Module and ENT Module are regarded as inappropriate and Urologic Instruments Module as uncertain.

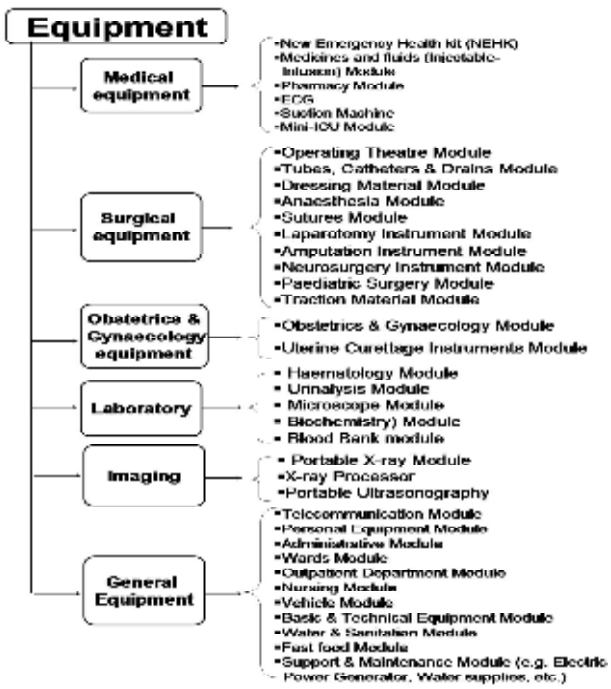

Figure 4: The appropriate equipment for the field hospital in earthquake

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As a conclusion, a multidisciplinary field hospital is composed of many assorted professionals and equipment that make it possible to comply with the needs of the earthquake sufferers. One caveat to bear in mind is that we have performed the RAND/UCLA Appropriateness Method in combination with Modified Delphi and Nominal Group Techniques for the first time to determine the field hospital setting for earthquake. Also there is lack of suitable evidence and grey areas, requiring more research and studies. This research is just a gateway to further efforts.

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