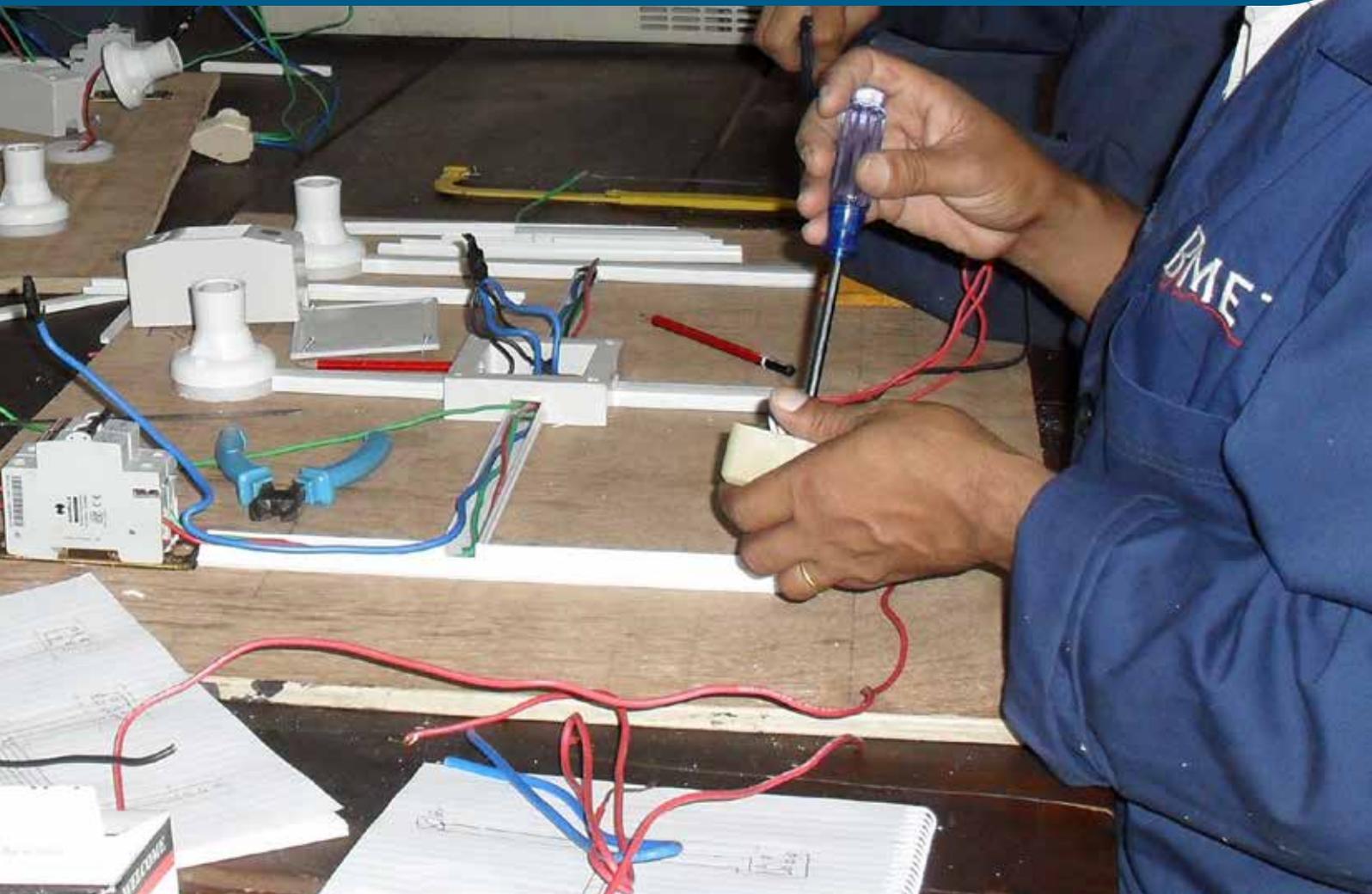
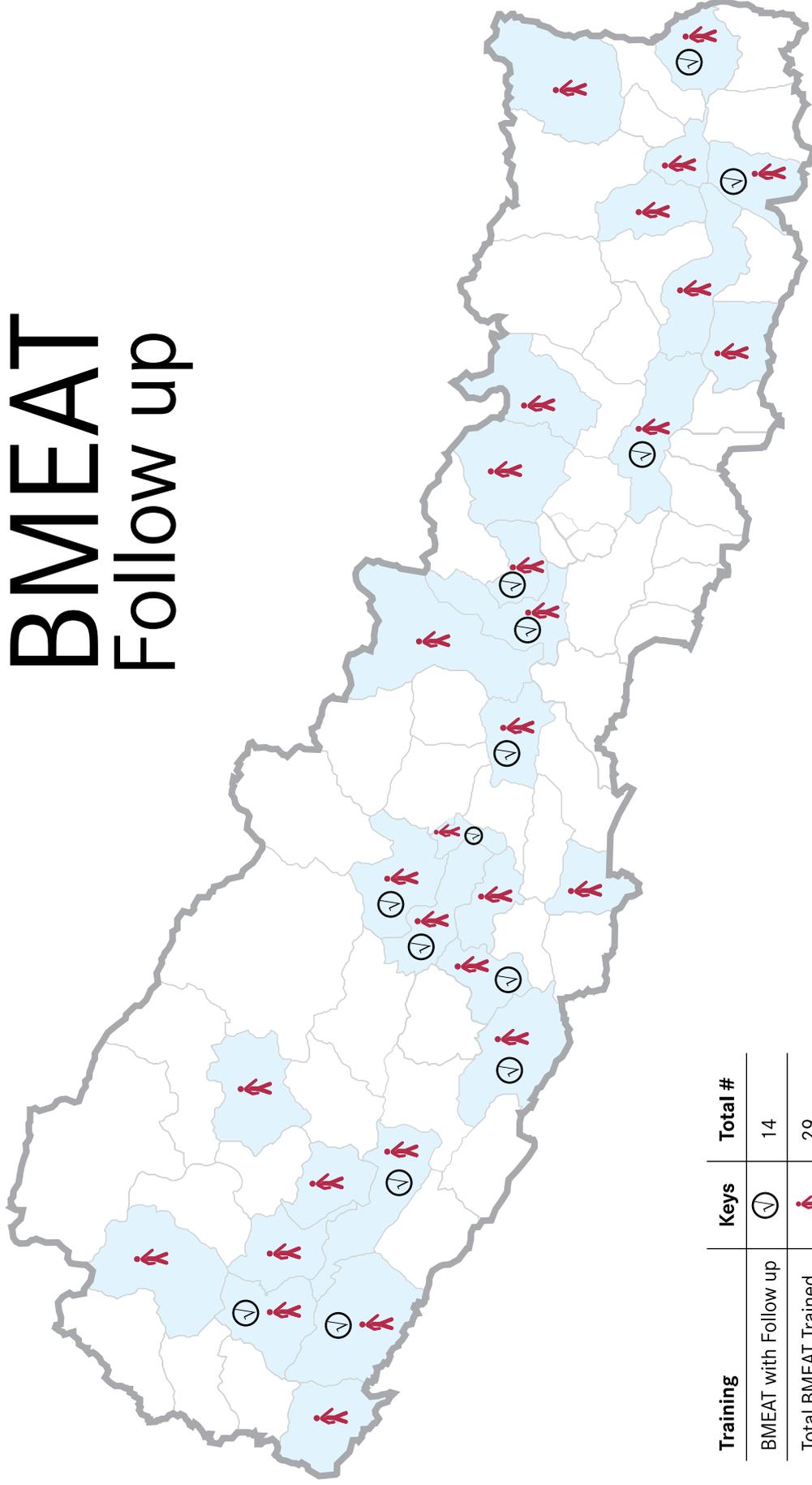


ENHANCING RURAL HEALTH CARE

# A Report of the Biomedical Equipment Assistant Technician (BMEAT) Follow-up Enhancement Process (FEP) May 2010



# BMEAT Follow up



Training	Keys	Total #
BMEAT with Follow up	⓪	14
Total BMEAT Trained	👤	29

ENHANCING RURAL HEALTH CARE

# A Report of the Biomedical Equipment Assistant Technician (BMEAT) Follow-up Enhancement Process (FEP) May 2010

**Conducted by**  
**National Health Training Center**  
**Biomedical Training Unit**  
**Nick Simons Institute**



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# 1. Executive Summary

## Background

A large proportion of medical equipment in Nepal's hospitals lies broken – often with problems that could be fixed with simple procedures. While the field of biomedical equipment repair and maintenance is well-developed throughout the world, it is still emerging in Nepal. Out of a need to maintain working equipment in the 65 district hospitals of Nepal, the National Health Training Center (NHTC) developed a 2-month course called Biomedical Equipment Assistant Technician (BMEAT), which complements its 1-year technician (BMET) course.

## Methods

In May 2010, the Biomedical Training Team conducted a follow-up and enhancement process (FEP) on 14 of the 29 graduates from the BMEAT training program. This covered 14 hospitals spread across mountain, hill, and Terai – and from east to far west. The four tools were 1. Trainee Questionnaire, 2. Supervisor Questionnaire, 3. Equipment Inventory and Observation, and 4. Case Story Collection.

## Results

- 12/14 (86%) BMEATs were making electrical repairs and 11/14 (79%) equipment repairs.
- No hospital had a workshop, so BMEATs worked out of their toolbox.
- Only 21% of hospitals had a system for preventative maintenance and only 21% made regular hours for the BMEAT's work.

- 12/14 (86%) supervisors said that they regularly called the BMEAT to make repairs. They said they appreciated better equipment condition and savings of costs.
- The BMEATs took extra steps to improve their work: 6/14 (43%) called the BMET trainers in Kathmandu for advice; 5/14 called their BMEAT colleagues in other hospitals; 2/14 called outside technicians for help. 12/14 requested that refresher trainings be conducted.
- The 14 BMEATs as a group worked on 20 pieces of equipment – which included nebulizers, suction machines, OT lights, BP machines, and even a few making minor repairs of lab and X-ray equipment. Repairs were usually quite basic: repairing wires, changing switches or other parts, cleaning and tightening.
- Four case stories provide real-life glimpses into the work.

## Conclusion

BMEATs return to posts in a government system that has not been developed to provide repair and maintenance of equipment: it lacks workshops, logbooks, and regular work policies. Nevertheless, the majority of graduates are making basic repairs to essential equipment. Both the graduates and their supervisors express

Even in this early stage, BMEATs are making significant contributions to their hospitals; this will become even greater if given support within the government health system.

appreciation for the training. In the future, BMEAT positions could be created by horizontal shift of existing posts. **Even in this early stage, BMEATs are making significant contributions to their hospitals; this will become even greater if given support within the government health system.**



# 2. Background

In Nepal almost 27% of equipment in the District Hospitals is not operational due to minor faults. These simple repair jobs could not be carried out due to the lack of skilled human resource and lack of awareness among hospital authorities for the need of technician support.

In 2004, Nepal's Ministry of Health passed the 'National Health Care Technology Policy', which mandated that, the government development a system for repair and maintenance of medical equipment.



In 2005, Nepal's Ministry of Health established the Biomedical Equipment Technician course under the National Health Training Center (NHTC).

Accordingly to the June 2008, Needs Assessment survey report by NSI and BMET training the following observation was found:

- Many items of equipment and utilities in health facilities need repair.
- A large proportion of maintenance needs could be met by the application of low level skills.
- Hospitals, even when small and remote, have a need for technician level support.
- Such support is not present in the districts.
- System initiatives are required to enact inventory and preventive maintenance of medical equipments.
- Hospitals need more support then at present in order to get

workshops to function properly.

- The only practical and cost-effective solution is to have in-house staff who can work on hospital equipment.

Considering these findings, in 2008 the National Health Training Center (NHTC), the Nick Simons Institute (NSI), Mr. Andrew (BMET Expert) and JHPIEGO designed and developed a 2-month course for district level support personnel, called Biomedical Equipment Assistant Technician (BMEAT) training. The BMEAT participant is trained to provide Repair and Maintenance (R+M) on 12 pieces of basic equipment and to conduct Preventive Maintenance (PM) on 7 of those pieces. There is evidence elsewhere in the world that training of a low level biomedical support cadre is a viable mid-term solution to the hospital equipment crisis.

In 2009 and 2010, with the support of NSI, NHTC conducted three batches of BMEAT. This consists of 29 permanent staff from 29 government district hospitals.

# 3. Rationale for Follow up Process

It is widely acknowledged that the effectiveness of training is heavily dependent on the support received by trainees after returning to their place of work. Trainees who display confidence and competence in the comfortable environment of the training site may feel considerably less confident in the demanding atmosphere of a busy work place, especially if they lack the support

of supervisors. The equipment may also be insufficient to enable them to retain all their new skills. A follow up visit by the trainer to assess the trainee's skills and provide on-site coaching and advice is therefore an essential part of the training and not just an add-on extra. It is also an opportunity to assess the effectiveness of the training and highlight any adjustments needed.

The National Health Training Centre (NHTC) has a stated policy of ensuring at least 30% of trainees receive follow up visits within any GoN training program. It was felt that, in addition to strengthening the BMEAT training, successful implementation of effective follow up within this major program would help to establish systems for follow up in other programs and generate trainer commitment to this practice.

# 4. Objectives of the Follow up Process

- To evaluate the effectiveness of BMEAT Training.
- To assess the nature of the working environment of the BMEAT trainee and their work pattern.
- To provide on-the-job support as well as create enabling environment for BMEATs.
- To feedback into improving the training and follow up.



# 5. Methods

- **Sample size:** Out of 29 BMEATs trained in the first two batches, we conducted follow-up on 14, this represent approximately 50%.
- **Service sites included and selection criteria:** 14 district hospital service sites were selected to receive follow up visit. These were based on representation of all development regions as well as mountain, hilly and Terai.
- **Follow-up Team:** BMET Team comprising of Bhawi P Gurung as a Team Coordinator, Suresh K Shrestha (Instructor) and Varsha Chaugai (Asst Instructor) were deputed for the follow up process. On average three trainers visited each site for two days. A Govt. micro van with a driver was provided by National Health Training Center (NHTC) for traveling around the chosen 14 districts.
- **Method of information collection and Tools:** To evaluate the performance and work pattern of BMEAT, we developed the follow up tools:
  1. Structured questionnaire for BMEAT participants
    - BMEAT work environment
    - Maintenance work done by the BMEATs
    - Feedback on BMEAT course and its usefulness
  2. Structured questionnaire for Supervisor
    - Hospital's R&M facilities
    - Attitude of the participants towards R&M work after training
    - Views about the training and LRP
    - BMEATs contribution towards betterment of hospital services
  3. Inventory equipment and workplace observation – also based on our results in interviews.
  4. Non-structured interviews and case study collection
- **Enhancement component:** On site coaching of BMEAT trainees and meeting with supervisor team was done to facilitate good working environment. The follow up team joined the BMEAT in repairing certain equipment in the hospitals.

# 6. Results

The Follow-up Enhancement Program (FEP) was conducted in Ilam, Sunsari, Sindhuli, Nuwakot, Dhading, Tanahu, Parbat, Baglung, Myagdi, Pyuthan, Dang, Surkhet, Doti, Dhangadi,. There, we interviewed our BMEATs and also the Section Officer, sister In-charge, Medical Superintendent, Maintenance Officer who were their supervisors.

## 6.1: Tool # 1: Participant Questionnaire (Discussion with trainees about their post training experiences)

Fourteen BMEAT participants were interviewed, one in each hospital.



### 6.1.1: BMEAT Work Environment

	QUESTIONS TO THE BMEAT PARTICIPANTS (14)	RESPONSES			
1	What are the Repair and Maintenance facilities in your Hospital?	14- No Workshop			
2	What maintenance work is done?	6 – Electrical, Equipment, and Plumbing	5 – Electrical and Equipment	1 - Electrical	2-No work done
3	Where are spare parts obtained?	12-Bazaar			2-No work done
4	What time is given for Repair and Maintenance (R+M)?	9 – Ad hoc basis	3-Daily		2-No work done
5	Any other technicians in the hospital for RM?	11 - Yes			3 - No



No hospital that we surveyed had any facilities dedicated to Biomedical Equipment repair and maintenance. The BMEATs had to work out of their toolbox. Also, there is no regular time set aside for them to do their work.

Despite this lack of a supportive system, many BMEATs report that they are conducting useful work. In 12 out of 14 hospitals there was ongoing electrical work being done, and in 11 out of 14 medical equipment was being evaluated and repaired. Spare parts usually

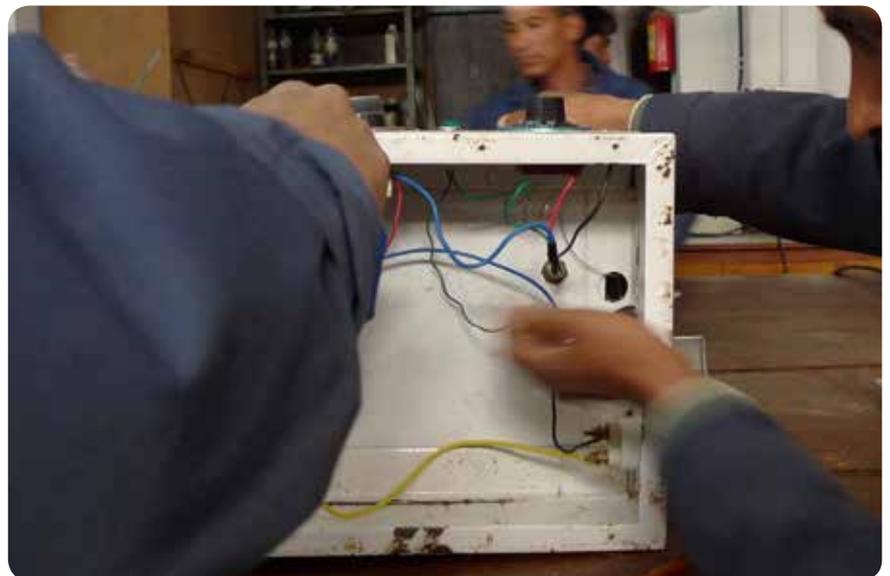
are brought from the local bazaar. In most of the hospitals, there were more than one staff attending to repair and maintenance.

### 6.1.2: Maintenance work done by the BMEATs

	QUESTIONS TO THE BMEAT PARTICIPANTS (14)	RESPONSES			
6	Do you record maintenance work in a log book?	1 - Yes	13 - No		
7	Are Pocket guide, Logbook and toolbox helpful?	12 - Yes	2 - No		
9	What actions do you take for complex repairs?	6-Consult BMET Teku	2 - Call tech from outside	1- Report to maintenance officer	1 - Store in 2 - No complex problem yet
10	Do you share problems with BMEATs in other locations?	5 - Yes	9 - No		
11	What are your difficulties in applying skills and training?	14 - No workshop	11 - No Time	1 - Spares unavailable	1 - No supervision

12 out of 14 BMEATs found the take-home materials – pocket guide, logbook, and toolbox to be helpful. However, again they suffered for lack of a system: only one has a routine of filling in a logbook. The lack of a workshop was mentioned again in this question.

There is evidence of the BMEATs motivation: 6 BMEATs (43%) go to the trouble of calling the BMET training center to ask for advice. Two (14%) called other outside technicians. Five (36%) call their BMEAT colleagues in other districts.



### 6.1.3: Feedback on BMEAT course and its usefulness

	QUESTIONS TO THE BMEAT PARTICIPANTS (14)	RESPONSES		
12	Did you improve your competence from the BMEAT training?	14 - Yes		
13	Do you share what you learned in the training with others?	4 - Yes	10 - No	
14	How could the BMEAT training be improved?	2- Better Lodging	2 - More DSA	1 - Longer duration
15	Any suggestion for further skill development?	9 - Refresher training	5- none	
16	Skills not covered during the training?			
17	Any changes suggested for LRP?	2-Yes	12 - No	

By their own qualitative assessment, all of the participants felt that they improved from the training. A few shared what they had learned, teaching others in their hospital. For the most part, their suggestions to improve the course focused on living features; 14% wanted better lodging and 14% wanted more DSA.

No one could name a skill that should have been covered during the training, and only

14% had suggestions for changing the LRP. Nine of the participants (64%) requested that some refresher course be organized.

### 6.2 Tool # 2: Supervisor Questionnaire (Discussion with the BMEAT supervisors)

A total of 14 supervisors were interviewed and asked for their opinions of the performance of BMEATs since their

training. Supervisors interviewed included the Section Officer, Sister In-charge, Medical Superintendent, and Maintenance Officer. The tables below show the over all impression of supervisor towards BMEATs after training.



	QUESTIONS TO THE BMEAT PARTICIPANTS (14)	RESPONSES		
1	Do you routinely call the BMEAT when hospital equipment is not working?	12 - Yes	2 - No	
2	Did the BMEAT returned from training with improved motivation?	12 - Yes	2 - No	
3	Have you ever looked at the BMEAT curriculum?	10- Yes	4 - No	
4	Is the BMEAT using his repair and maintenance skills?	9 - Yes	5- No	
5	How has the BMEAT helped the hospital?	7- Keeps equipment in good condition.	5-Saves hospital money.	2 - No work done.

A larger proportion of BMEAT supervisors (86%) call the participants to repair broken equipment in the hospital. But only 64% said that they were using their full skills. They made comments that before the training the staff knew nothing, but since

training they are capable to perform repair work. An equally large number felt that the participants returned to the hospital more motivated to take on biomedical maintenance work.

When asked how the BMEAT has helped the hospital, 50% said that equipment is kept in good condition and 35% reported cost savings.

	QUESTIONS TO THE BMEAT PARTICIPANTS (14)	RESPONSES		
5	How does your hospital allocate time for repair and maintenance work?	9 - Ad hoc basis	3 - Daily	2 - Not at all
6	Does your hospital have a preventive maintenance system?	3 - Yes	11 - No	
7	Is the BMEAT doing regular preventive maintenance?	3-Yes	11 - No	

Although supervisors identified a need that the BMEAT could address, in only 3 hospitals (21%) was there any regular time allocated for the BMEAT to perform his work. Only in three hospitals (21%) was there system for conducting preventive maintenance on its equipment. Not surprisingly, it was only in those three hospitals that the BMEAT was doing PM work.

**6.3 Tool # 3: Inventory equipment and workplace observation**

The follow up team examined registers, inspected equipment, and conducted interviews to determine repairs that the BMEAT participants were performing. The table below records the number of BMEATs (out of 14) who have done repairs (at least

one time) on specific pieces of equipment. The particular repair procedure is recorded on the right.

Twenty different pieces of equipment were repaired by the 14 BMEATs. These covered a wide range of locations throughout the hospital: outpatient department, inpatient

SN	LIST OF EQUIPMENT REPAIRED	# BMEATS WORKING ON THIS PIECE ( / 14 TOTAL)	PERCENTAGE	REPAIR PERFORMED
1	Nebulizer	11	79 %	Switched changed, wire repair, burnt connection rectified
2	Suction Machine	11	79 %	Clean pipe, fitting tubes, wire& 3-pin changed
3	Blood pressure Machine	10	71%	Inlet clean, bladder& manometer change, cuff licked rectified
4	OT light	8	57%	Loose connection tightened, bulb and wire changed
5	Oxygen Cylinder	7	50 %	Flow meter changed, regular cleaning
6	Autoclave	7	50 %	Heater changed, gasket changed, wire connection
7	Stethoscope	6	43%	Pipe clean, air piece changed
8	Simple Electricity	6	43%	Installed Inverter, wiring socket
9	Centrifuge	5	36%	Clean carbon brush change
10	Weighing Machine	4	29%	Adjustment of Needle
11	Oxygen Concentrator	4	29%	Humidifier bottle repaired, filter clean
12	Water Bath	4	29%	Broken wire repaired, thermostat changed
13	X-Ray Machine	3	21%	Exposure switch changed, Fuse changed
14	Resuscitation Machine	3	21%	Bulb changed, wire changed
15	ENT Set	3	21%	Bulb changed
16	Microscope	2	14%	Bulb changed
17	ECG	1	7%	Clean lead
18	Cautery machine	1	7%	Electrode connection made proper
19	Ultrasound Machine	1	7%	Preventive maintenance
20	Lab Incubator	0	0%	



ward/nurses' station, X-ray, operating theater, laboratory, as well as general hospital maintenance areas, such as electrical supply. There was almost no area of the hospital that is not covered by this list.

The most common pieces of equipment needing repair were nebulizer, suction machine, BP machine, and OT light. More than half of the BMEATs worked on each of these machines in their hospitals. The list indicates that basic level of repair was required: switches, wires, and bulbs; cleaning and tightening connections. Though basic, each of these could make the difference in whether the equipment functions or not.

# 7. Case Histories

## Case History 1– Trisuli Hospital, Nuwakot

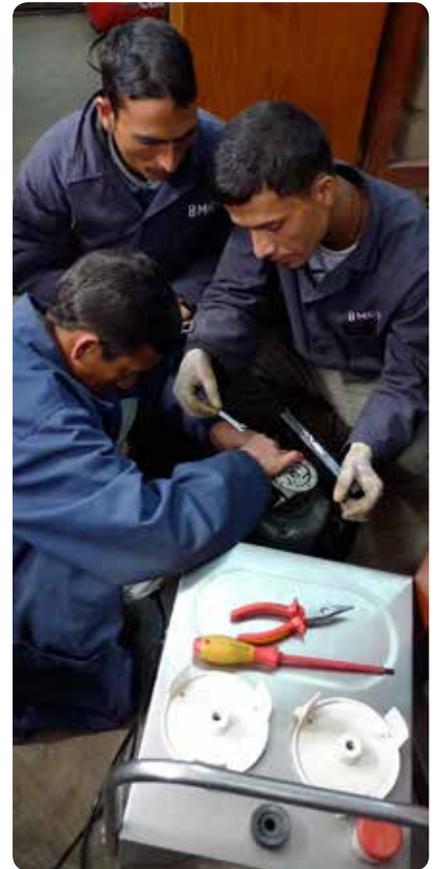
Dan Bahadur Ghale, a 1st batch BMEAT trainee has been working on Repair & Maintenance of Trisuli Hospital effort. As a support staff of the hospital, he is made to do his regular duty of issuing tickets at the hospital till 2 pm. Still, he involves himself for R & M daily after 2pm at the same room where he issues the ticket. Before, the hospital did not have any manpower to troubleshoot the equipment. But after BMEAT training, Dal Bahadur handles most of the hospital devices and also looks after simple electrical problems in the hospital. His supervisors & hospital staffs are extremely pleased with the R & M work he has been doing & they count on him if any machine gets broken.

The training he received instilled in him the ability to analyze and solve problems on almost all of the faulty equipment. When

spares are available, he rectifies them as well.

Once, the only oxygen concentrator in his hospital stopped working. When he was called, he could see that the filter of the concentrator was blocked. He immediately cleaned it and when he operated the machine, it was functioning properly. Had he not received the training, the concentrator would have been either dumped in the store or technician from Kathmandu had to be called in just for a simple problem of filter blockade.

Even though he has no proper workstation and time to carryout his R & M work, he realizes his responsibility as an BMEAT and amid all the difficulties, he is tirelessly working on R & M with a hope that someday he would be provided with the conducive environment for this work.



## Case History 2 – Rapati Zonal Hospital Dang

An ultra sound machine has been provided for diagnostic purpose. This service was being provided for a long time which stopped suddenly due to a simple problem. The problem was that the measuring cursor was not moving well. Concerned doctor requested the engineers to fix it. But they just escaped saying that whole section of measuring cursor has been damaged and that is to be replaced. For this, a large amount of money was required to repair it. Different organizations were asked to provide money, but it didn't materialize.

At last, BMEAT Pradeep Chaudhary made a phone call to me (Suresh Shrestha, BMET Trainer) and I suspected and suggested him that there might be presence of dust in the mouse roller. Repairing this is difficult work for Pradeep because he has not been taught to open the ultrasound machine in his training. Even though, as per my advice, he opened the mouse and indeed he found the presence of dust. He cleaned the dust and the machine began to work smoothly. Thus, a huge amount of money was saved and can be used by the hospital and needy patients started to get proper ultrasounds.

### Case History 3 – Doti District Hospital

Doti District Hospital is in rural area of Far Western Region, where situation of medical equipment and utilities are not maintained properly. In any case, previously whenever the equipment or utilities got a simple problem (even like blown fuse or

disconnection of wire) they were kept in the store idly. This was because of unavailability of semi skilled or skilled manpower in that remote place.

However, Mr. Madan Upadhaya obtained BMEAT training and he started to look after all utilities and medical equipment of the

hospital. Due to his great effort to keep the medical equipment functional of there, he was awarded the best government staff prize for the year of 2066 in Doti District. Nowadays, hospital gets more relief from the problems of medical equipment and utilities. As a result, users are also satisfied to see the improved status of the hospital.

### Case History 4 – Jiri Hospital

Mr. Ganga Bahadur Jirel is a support staff of Jiri hospital – a government district hospital run by a local Hospital Operating Committee. This hospital is a low service utilization hospital among district hospitals of Nepal, so the income of hospital is also low and they cannot afford many staff salaries.

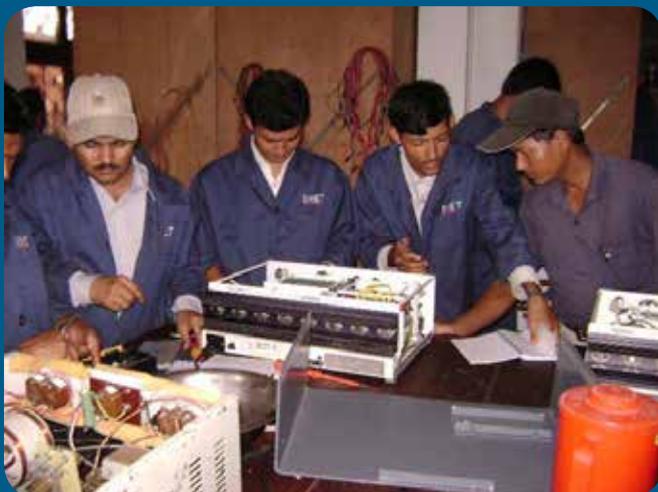
Ganga received BMEAT training from NHTC/ BMET training center in the 2nd batch. Like his colleagues, he is doing regular duty – morning, evening and night rotationally. In spite of his regular work, he does repair & maintenance work daily after completion of his regular duty. Before his training the hospital did not have any staff to troubleshoot equipment. But after BMEAT training, Ganga Bahadur can handle most

of the hospital devices and also looks after simple electrical problems.

His supervisors and hospital staffs are extremely pleased with his repair & maintenance work and they call him if any machine gets broken. According to his supervisors and other hospital staff, Ganga can solve more than 70% of maintenance work of the Jiri hospital.



# Glimpses





# 8. Appendix

## QUESTIONNAIRE FOR FOLLOW UP OF BIOMEDICAL EQUIPMENT ASSISTANT TECHNICIAN (BMEAT) TRAINING

Hospital Name:

Address/Contact Nos.:

District:

Date of Survey:

A: Questions for Hospital Superintendent

### 1. STAFFING

Staff	Govt posts allocated to the Hospital	No. of people in post	Actual nos. of people working at Hospital
Doctor			
Lab Technician			
Lb Assistant			
X-ray Technician			
X-ray Assistant			
Maintenance Technician			
Peon/Cleaner			

1. Comments on any maintenance staff problems:				
2. Is there a Hospital (Developing/Helping) Committee?	Yes	No		
3. Does it discuss on maintenance?	Yes	No		
4. What discussion do you do on maintenance?	Electricity maintenance	Infrastructure maintenance	water supply maintenance	Hospital equipment
5. Has it a maintenance budget?	Yes	No		
6. Is this budget used?	Yes	No		
7. Do other groups (NGO, INGO, DONORS etc) help the hospital for maintenance in any way?	Yes	No		
8. If yes, who and how?				
9. Do district government offices help the hospital? If yes, how?	Yes	No		
10. Do they help with maintenance? If yes, how?	Yes	No		
11. What happens to equipment if the hospital cannot repair?	Put in store	sent to MOH	Taken to bazaar	outsourcing

**B: Questions for BMEAT**

Name of Trainee:

Training Taken Date:

Working Hospital during Training

Present Working Hospital

1. What are the Repair and maintenance facilities?	Appropriate workshop	Adequate Nos. of tools		
2. What kind of maintenance work do you do in your hospital?	Electrical	Infrastructure	Water supply /Plumbing	Hospital equipment
3. From where does the hospital obtain medical equipment spares?	bazaar	LMD	Other	Nowhere
4. Are you given time specifically for repair and preventive maintenance work?	Yes	No		
5. Are there any other technicians involved for equipments Repair and Maintenance?	1 No.	2 Nos.	more than 2 Nos.	
6. Have you started PM and RM Recording System in Log Book?	Yes	No		
7. Is BMEAT Pocket Guide, Logbook, toolbox helpful to you?	Yes	No		
8. Do you think that Pocket Guide, Logbook, toolbox needs to be improved?	Yes	No		
9. How?				
Pocket Guide	By adding more information about the equipment	By adding more pictures of different parts	By adding more problem solving tips	other
Log book	Format modification			
Toolbox	add more tools			
10. When the repair is complex, what is your immediate action?	Call technician from outside	Request to Develop/ support committee	Keep them in store	Request to LMD/BMET Lab
11. Do you communicate with other BMEATs when the problem in equipment arises?	Yes	No		
12. Do you find any improvement after the BMEAT Training?	Yes	No		
13. Which skills have you found useful in your work since you came back from training?				
14. Have you been able to orient and shared the skills that you have learnt in the training with your colleagues, which areas did you shared?	Yes	No		
15. Are there any skills, content not covered in the training and that needed to be added in the curriculum?				
16. Are there any additional tools or resources that you feel, that need to be added or covered during the training?				
17. What do you suggest for the further skill development?	Refresher Training	Specialised Training	Other	
18. Are any of your suggestion are taken for maintenance?	Yes	No		
19. Have you had any difficulties applying the skills and training? Any suggestions to address these challenges				
20. How are you managing your time repairing equipments?				
21. Do you have any questions or are there any areas related to the training for which you would like more guidance??				

C: Questions for In-charge

1. Is there any skilled maintenance staff appointed in your hospital?	Yes	No		
2. If yes then does your maintenance staffs do any other work?	Yes	No		
3. If No then what are the other options?	Ask for maintenance staff	Outsourcing	Want to train any staff	Others
4. Do maintenance staff give time specifically for maintenance work?	no maintenance staff	Staff do nothing	work less than once a week	work every day
5. What is your immediate action when any equipment breaks down?	call technician from outside	Use alternative equipment if any	request to repair from LMD	
6. Is the equipment sufficient?	Yes	No		
7. Is water supply sufficient?	Yes	No		
8. Is electricity supply sufficient?	Yes	No		
9. Is there a preventative maintenance system being used?	Yes	No		
10. What are the hospital's needs for maintenance?				
11. How do you find your support staff (participant) after BMEAT Training?				
12. Is he using skills that he got from the training?				
13. How is he managing his time for maintenance work as well as other regular duties?				
14. Did you see the materials that were provided to him after training? Pocket Guide, Logbook, Tool box				
15. How do you find it? Does it need to improve?				
16. Is he doing regular PM work?				
17. Motivation after training? Did you find any changes in attitude after training?				