

# Safety of Electro-Medical Equipment in Floods in Austere Environment

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## ABSTRACT

Pakistan is prone to floods. In 2010, floods in North-Western Pakistan caused devastation in wide areas. Electro-medical equipment is very expensive and without proper equipment adequate surgery is not possible. We retrospectively analyzed how expensive electro-medical equipment got damaged during floods of 2010 at a district-level hospital in North-Western Pakistan and how we could have saved this equipment or reduced the damage to the minimum. The article provides the lessons learned and recommendations aimed to prevent or minimize damage to the valuable and expensive equipment in the areas prone to floods. (*Disaster Med Public Health Preparedness*. 2018;12:803-805)

**Key Words:** electro-medical, equipment, floods, disaster management

Natural calamities like earthquakes or fires are so sudden and overwhelming that we are usually caught in an unprepared state and one is indecisive about what to save, how to save, and in which order. To save one's own life, that of the loved ones and fellow human beings is naturally the first priority. Public property even if very expensive gets the last priority. Floods in contrast to other natural calamities do give a reaction time and if one keeps his nerves he or she can avoid great losses by simple measures. In the wake of global warming and recent heavy snowfalls the floods are likely to increase and the importance of these measures is increased many fold. By virtue of its peculiar geographic situation and global warming, Pakistan is prone to floods every year. Unfortunately due to poor governance, corruption, and inefficient management of resources proper preventive measures have not been taken to safeguard against this natural calamity.

Flooding not only damages infrastructure of a hospital but also damages expensive electro-medical equipment. In a country like Pakistan procurement of this equipment is a lengthy process. The non-availability of one part or component of equipment renders the available items of little use. So every effort should be made to protect it and keep in good working condition.

We describe our experience at a district-level hospital during the flood of 2010 that affected a large area in North-Western Pakistan, affecting one-fifth of the country and making over 7 million homeless.<sup>1</sup> Our hospital is a district-level hospital located in the city of Nowshera and it suffered great losses in the floods of 2010. Although we learnt many lessons, this paper is

about a particular aspect of disaster management that is safety of electro-medical equipment during floods and measures which could have been taken to minimize the damage.

This paper is an endeavor to help improve our preparedness for floods by sharing our experience during floods of 2010 with special emphasis on protecting costly orthopedic equipment. This thinking can be extended to include other costly equipment purchased from poor taxpayer's money.

## MATERIALS AND METHODS

We observed the effects of floodwater on electro-medical equipment during the devastating floods of 2010. The concept of the study was approved by ethical review committee. The extent of damage and steps which could have been taken to minimize the damage were analyzed retrospectively. Important and expensive electro-medical equipment which was damaged during the floods was included in the study. Any equipment which was already out of order was excluded from the study. There were many devices that were not affected by floods because of being placed at higher ground. Following is brief account of equipment damaged and steps which could have been taken to minimize the damage.

### Image Intensifier (C-Arm)

This was the most expensive equipment damaged. The one with us costs Pakistan Rupees (PKR) 6.5-10 million (almost 65,000-100,000\$). It is huge and heavy and very difficult to be lifted and transported to some other place. Transportation in hurry, without proper care, can lead to more damage due to jolts and

jerks. When the floodwater started to pour in, we could not think of anything else but to shift it to a safe higher place. As there was floodwater inside the operating theater the cable of footpad got entangled and was broken. With great difficulty it was loaded in a truck but due to floodwater it was not possible to exactly see edges of the road. So the wheel of the truck went off the road, sunk in mud, and toppled on its side. During the rest of the flood it remained outside in open soaked in mud and rain water. We spent 300,000 PKR to get it into working order again. The printer required another 300,000 PKR for repair. As we could not afford it so we left it as such. Thinking retrospectively the image intensifier should not have been moved. Its printer could have been removed and C-arm itself could have been covered in strong polythene bag whose ends could have been tied with some oil or paraffin applied to act as water repellent. We retrospectively observed that during these floods that water did not enter in oil cans or utensils containing oil. Even if small amount of water had entered it would have been without the sticky mud which causes the major damage and is very difficult to remove.

### Orthopedic Operating Table and Power Drill with Attachments

Our orthopedic operating table costs around 2.5 million PKR. Muddy water gained access to the hydraulic system which went out of order. Despite spending half a million rupees it could not be properly fixed. Orthopedic extensions (locally manufactured) costing PKR 60,000 were left in floods and got rusted. These could have been saved by coating them with oil alone.

Power drill system was another expensive item which was rendered useless by floods. We could have saved its compressor by simple measures of packing in polythene bags. But it was ruined by flood and could not be repaired. Implants and instruments were also affected by muddy floodwater. We did not have time to remove them to a safe place or put them into a polythene bag. We could have saved them by rinsing in clean water and drying immediately after flood but due to chaos and confusion at that time and delayed restoration of electricity and water supply they got rusted and were rendered useless.

### Other Equipment

Other medical equipment like Ventilators, anesthesia machines, workstations, ECG machines, portable image intensifier, and patient monitors were also damaged by floodwater and mud. The tubes were clogged by mud and had to be replaced. This damage could have been reduced to minimum had we detached the monitors and carried them to a safe location and covered the immovable equipment with some polythene bag. One of the ventilators in intensive care was saved as it was covered in a plastic cover.

Similarly the damage to mobile X-ray machine could have been minimized had we covered the tube head and the console with some plastic covers.

Radiology equipment is probably the most expensive in a hospital. We were lucky that our radiology department was located at a higher location so the floodwater did not do much damage, otherwise it would have been a catastrophe. From our experience we recommend that such departments may be located at higher grounds with all the protective measures like drains and construction of flood barriers around such equipments. The hospital also needs to identify important or sensitive components of this equipment which can be covered by plastic bags or some waterproof wraps or if possible these can be detached from the main machine and carried to a safe location in flood season or when there is flood warning.

## DISCUSSION

*“Human beings, who are almost unique in having the ability to learn from experience of others, are also remarkable for their apparent disinclination to do so.”*

(Douglas Adams, “Last Chance to See”)<sup>2</sup>

Floods of 2010 in Pakistan were a big disaster, killing 1600 people, 10,000 cattle, displacing 14 million people, and destroying 1.4 million acre of crops.<sup>3</sup> In Pakistan we are faced with frequent disasters but unfortunately we have not evolved any robust system for management of disasters. In addition to natural disasters we have to deal with terrorist attacks.<sup>4</sup> There is no doubt that our health system has improved to deal with such incidences, we still have a long way to go. Disaster management is so important subject that it should be a part of medical curriculum<sup>5</sup> so that our doctors are better trained and prepared to cope with such difficult situations. Trained medical students can contribute significantly in case of disasters and help fill the deficiency of skilled workforce.<sup>6</sup> Unfortunately, in our universities, this important topic is ignored both in under- and postgraduate levels.

In case of every disaster all modes of communication are broken down. There is no electricity, no phones, roads are unsafe. In these “golden hours” it is the trained locals who can reduce the damage.<sup>7</sup> It was our first experience with such a disaster. We were caught unprepared. We did not receive any flood warning even when we saw water affecting low lying areas across GT road. We were in a constant state of denial; we did not have any plan of evacuation of patients and equipment. To us the first priority was human lives and that what we did. We directed all our efforts to save patients and personnel. Safety of equipment was second priority.

To avoid such a situation, we need to have a clear plan to handle any disaster if we are to avoid any confusion; and this was what we lacked and as a result some expensive equipment got damaged.

All departments should maintain a list identifying items of equipment and their location and the order in which they should be salvaged. Copies of these should be held centrally.

If there is heavy equipment which cannot be moved as a whole, its important parts should be salvaged. Priority is human life and usually all efforts are focused on it. If a separate properly trained “Equipment Salvage Team” is included in the disaster management plan it would make it easier to salvage this expensive equipment. This team should include technically sound biomedical engineers or technicians who can not only salvage critical equipment but also take ownership of repairing them if they get damaged during floods.<sup>8</sup>

## RECOMMENDATIONS

- Disaster management should be a part of medical education in under- and post-graduate level.
- Every hospital should have a clear and simple plan to evacuate patients and equipment in cases of a natural disaster. Hospitals should be inspected and rated according to WHO Hospital Safety index.<sup>9</sup>
- Damage to the expansive equipment by floodwater can be minimized by simple measures like siting sensitive and expensive equipment at a higher ground, building protective structures around them and covering them in a polythene bag sealed by paraffin.
- Heavy equipment should not be moved in emergency as these may get more damage. More sensitive and delicate parts may be detached and saved instead.
- Equipment Salvage Teams should be included in disaster plan so that critical equipments can be salvaged as much as possible.

## CONCLUSION

Natural disasters are a reality. We do not take the likelihood of any disaster seriously till we experience it ourselves. In view of changing climatic conditions flood are more likely to affect us, preparedness with simple precautionary measures can go a long way to reduce the adverse effects and save precious national resources. Hospitals need to play an important role

in case of a disaster and every effort should be made to keep them functional by appropriate design and a clear plan of action during a calamity.

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