# PORTABLE MULTI-PERIPHERAL TELEMEDICINE KITS TO EXPAND CLINICAL SERVICES OF RELIEF ORGANISATIONS IN CONTEXTS OF DISASTER

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## Abstract

**Objectives: This study explored the practical aspects of multi-peripheral portable telemedicine kits that make them specifically ideal for expanding and improving the medical services provided by disaster relief organisations. It also attempted to compile a list of proposed criteria and components of a standard disaster portable telemedicine kit. Methodology: Descriptive study extracting data by review of published research articles and manufacturer documentations, and reports of some humanitarian organisations.**

**Results: The study revealed that portable telemedicine kits help delivering timely, high-quality, and safe general and specialty medical service in disaster situations. Moreover they increase the capacity to serve greater numbers of affected people. A list of criteria was compiled from reviewed data to suggest a standard disaster portable telemedicine kit. Conclusion: Portable telemedicine kits expand the capacity of the delivered healthcare service of a relief organisation qualitatively and quantitatively. Portable telemedicine kits with disaster- specific criteria are recommended for relief organisations.**

**Keywords:** telemedicine; e-Visit; portable kits; disaster

## Introduction

Disasters cause disruption of the physical infrastructure of healthcare facilities, loss of healthcare personnel due to death, injury or disease,[1] destruction of the lifelines serving healthcare facilities such as water, roads and transport,[2] and increased demand and rush for use of the healthcare system.[1] This results in reduction of quality, safety and accessibility to health services.[3]

Telemedicine contributed to overcoming the problems of shortage of healthcare services and the scarcity of specialties in different situations.[4-6] eHealth innovations provide many options for delivery of specialised healthcare in several situations including disaster contexts. The industry has designed and manufactured several forms of integrated telemedicine units that are compact, movable and with high performance such as stations, carts and portable telemedicine kits (PTKs), beside individual separate telemedicine devices or sensors (e.g. e-stethoscope, e-ophthalmoscope, e-ECG).

The study aimed at exploring the practical aspects of multi-peripheral portable telemedicine kits that make them ideal for expanding medical services provided by disaster relief organisations. An attempt has been made to compile and propose a list of criteria and components of a standard disaster portable telemedicine kit.

## Methods

This study is a descriptive review of online data about the use, types, and specifications of portable telemedicine kits. Data were extracted from published research and manufacturer documents and reports from some relief organisations that practice telemedicine.

## Results

Several studies proved the positive role of telemedicine in disaster contexts in delivering high quality, timely medical assistance, improving future disaster medicine outcomes,[4] augmenting existing medical services and developing new ones.[7] Valuable interactive consultations by remote medical specialists can be provided to onsite physicians in disaster locations.[8] The acute need for establishing

telemedicine programmes in areas at high risk for disasters is reported.[9] Some relief and non-profit organisations recognised the advantages of telemedicine and started using it in their programmes. Large organisations such as NATO[10] and MSF[11] went further to establish entire programmes based on telemedicine.

***Portable multi-peripheral telemedicine kits (PMTKs)***

Compact integrated portable kits in suitcase form are suitable in situations that require much moving, changing places, rapid evacuation, and limited space. They are also helpful in providing medical consultations for different specialties using their attached/attachable peripheral diagnostic devices. The USA army's first portable telemedicine unit was built in 1993 and comprised a ruggedised videoconferencing unit. It was initially used in the United Nations' operations in 1994 in Macedonia and Haiti.[12] Industry headed for manufacturing portable telemedicine kits in packages that in addition included software and cloud medical decision support.

PMTKs proved to be useful in: a) healthcare service by providing the means to deliver timely, high quality, specialised healthcare for large numbers of people;[13] b) eliminating costs and time used for travel by large numbers of onsite staff and physicians. Patients save time and money spent on journeys to seek specialist physicians away from their home;[13] c) security and safety is improved by the reducing the number of staff and physicians required onsite, thus eliminating much of the security risks of travel, accidents, infection and potential hazards posed in the disaster location. Safety of patients is also increased by the possibility of moving the 'portable clinic' nearer to them and away from potential harm sources;[6] d) other theoretical benefits are increasing and encouraging volunteerism (e-volunteerism by specialist physicians), fostering research in the area of disaster medicine, and use for online skill education and training.[14,15]

***Characteristics of proposed ideal disaster PTK***

The suggested specifications of PTKs that should ideally be present to deliver multispecialty clinical care in a disaster, fall into three groups, general, disaster-specific, and optional.

***General specifications***

These are the specifications that distinguish the portable kits and favour their functioning for the entire scope of intended purposes and situations including disaster contexts.

a. *Portability.* The main properties of portability are that they are compact, in an all-in one case,[13,16] and light weight to facilitate lift-ability and move-ability.[17,18]
b. *Simplicity of assembling and operating.* Automatic or easy operation with clear simple written or drawn manual, as well as a simple software interface is essential in disaster situations where reaching an IT expert is difficult.[6,19]
c. *Multi-peripheral input ports.* Presence of multiple ports for plugging in extra sensors and devices broadening the range of clinical specialties provided and preparing for newer future add-ons.[19]
d. *Multiple connectivity options.* These allow choice of available network connection e.g. GSM, UMTS, ISDN, DSL, Satellite). This is especially useful in areas where Internet and network connectivity are not stable or damaged, providing a great communication convenience to the physician.[20,21]
e. *Long-life rechargeable battery.* These are great help in situations of power outages especially if prolonged.

***Disaster-specific specifications***

These are prioritised or additional specifications that should essentially be considered when deploying PTKs to disaster-stricken locations.

a. *Durability.* Conditions in a disaster situation may not favour keeping equipment away from damage e.g. in case of floods or typhoons wetness is probable and in earthquakes falling of objects may crack or break the case. The PTK should therefore be robust and durable ie solid, non-rust, dust, water and puncture-proof, and weather-fast.[19]
b. *Safety.* Due to presence of potential hazards at a disaster scene or location, and depending on to the type of disaster extra precautions should be considered. The PTK case material should be non-radiating, with non-flammable material lining its fabric. It should also be electrically insulated.
c. *Smaller size.* In some disaster contexts space is limited, and the dimensions of the PTK should be selected carefully to enable fitting in transport on the way and easy accommodation in the space assigned for it.[22]
d. *Border / flight clearance.* When deploying PTKs

to a disaster location which could be hundreds or thousands of miles away, the journey may include border-crossings. PTKs therefore should conform to the regulations of travel and air transport. The weight limit, size and contents (e.g. magnetic material) often matter.

e. *Multi power socket inlets.* PTKs should come with multiple power inlets for plugging-in cables of different power sources. It is common in a disaster area for camps or buildings to be powered by local generators or solar cells with different plug configuration.
f. *Extra rechargeable battery*. In disaster areas, power source may go off for extended time and the original battery may also consume all its charge, so there is need for charged spare-battery.

***Optional specifications***

These are extra specifications that are offered as added functions, or preferences that can improve general or specific performance but are not essential for operation. Some options include:

a. *Low cost of the kit.* In case of budget constraints.
b. *Wheeled Suitcase.* Facilitates moving on smooth paved ground e.g. in airports and platforms.
c. *Remote control(s).* Facilitates operating and minimise cluttering for cables.
d. *Colour.* Colour of the outer case of the kit may be a preference, especially for social, cultural, psychological or safety caution reasons.

## Discussion

Telemedicine in the form of portable units has been used by relief organisations in different situations such as refugee camps, remote locations and disaster-stricken areas. In many instances the relief organisation might have compiled their own potable unit by combining its parts around a laptop or tablet then adding peripherals or sensors as required, mostly for limited clinical purposes such as ophthalmology,then adding peripherals or sensors as required, mostly for limited clinical purposes such as ophthalmology, dermatology or cardiology. The all-in-one portable

stricken areas. In many instances the relief organisation might have compiled their own potable unit by combining its parts around a laptop or tablet telemedicine kits with customisable peripherals increase the possible ways of introducing different medical specialisations beyond the general practice. This leads to delivering specialised healthcare that increases the number of people served and also presents timely (sometimes life-saving) high quality medical service with specialisations.

From the study a criteria list for a suggested standard disaster portable telemedicine kit (SDPTK) was compiled (Table 1).

***Limitations***

This study researched PMTKs on physical and functionality criteria. It did not explore the sophisticated technical software or hardware specifications, cost analysis or financial issues.

## Conclusions

PMTKs help in providing safe high quality multi-specialty medical service in disaster contexts. A suggested list of criteria towards a standard portable telemedicine kit was extracted from the study data. Adding improvement to the list from further research is recommended to reach the ultimate perfect list. The study recommends making PMTKs essential components of every disaster relief organisation.

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**Table 1**. Criteria suggested for the standard disaster portable telemedicine kit (SDPTK).

| Essential general criteria | Essential disaster-specific criteria | Optional criteria |
|---|---|---|
| • Portability<br>• Simple assembling and operating<br>• Multi-peripheral input ports<br>• Multiple options for connectivity<br>• Long-life rechargeable battery | • Durability<br>• Safety<br>• Smaller size<br>• Border / flight clear<br>• Multi power socket inlets<br>• Extra rechargeable battery | • Low cost of PTK<br>• Remote control<br>• Wheeled Suitcase<br>• Colour |

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## References

1. Shoaf KI, Rotiman SJ. Public health impact of disasters. *Aust Emerg. Manage* 2000;15(3):58.
2. Cole S. Lifelines and livelihood: a social accounting matrix approach to calamity preparedness. *JCCM* 1995;3(4):228-246.
3. World Health Organization (WHO). Presentation: Impact of Natural Disasters on the Health System in Africa. Available at: http://www.preventionweb.net/files/11214_WHOpresentationontheimpactofnatural.pdf accessed 29.January 2017.
4. Garshnek V, Burkle FM. Applications of telemedicine and telecommunications to disaster medicine. *JAMIA* 1999;6(1):26-37.
5. Asemota E, Kovarik CL. State of the art and science. *Virtual Mentor* 201;16(12):997-1001.
6. Ajami S, Lamoochi P. Use of telemedicine in disaster and remote places. *J Educ Health Promot* 2014;3(1):26.
7. Cadger F, Curran K, Santos J, Moffett S. Location and mobility-aware routing for multimedia streaming in disaster telemedicine. *Ad Hoc Netw* 2016;36:332-348.
8. Houtchens BA, Clemmer TP, Holloway HC, et al. Telemedicine and international disaster response: medical consultation to Armenia and Russia via a Telemedicine Spacebridge. *Prehosp Disaster Med* 1993;8(1):57-66.
9. Latifi R, Tilley EH. Telemedicine for disaster management: can it transform chaos into an organized, structured care from the distance. *Am J Disaster Med*. 2014;9(1):25-37.
10. AMD telemedicine. Available at: http://www.amdtelemedicine.com/blog/article/3-surprising-places-doctors-are-using-telemedicine-treat-patients accessed 20 January 2017.
11. Doctors Without Borders (MSF). (2016). Website. Available at: http://www.doctorswithoutborders.org/article/msf-telemedicine-brings-care-patients-remote-areas accessed 28 January 2017.
12. Navein J, Fisher A, Geiling J et al. Portable satellite telemedicine in practice. *J Telemed Telecare* 1998;4(Suppl 1):25-28.
13. Kontaxakis G, Walter S, Sakas G. EU-TeleInViVo: an integrated portable telemedicine workstation featuring acquisition, processing and transmission over low-bandwidth lines of 3D ultrasound volume images. In Information Technology Applications in Biomedicine, 2000. Proceedings. 2000 IEEE EMBS International Conference on 2000 (pp. 158-163).
14. Llewellyn CH. The role of telemedicine in disaster medicine. *J Telemed Telecare* 1995;19(1):29-34.
15. Bashshur RL. Telemedicine effects: cost, quality, and access. *J Med Syst* 1995;19(2):81-91.
16. Adler AT. A Cost-Effective Portable Telemedicine Kit for Use in Developing Countries (Doctoral dissertation, Massachusetts Institute of Technology 2000)
17. Senacare. Brochure of the Telecare mobile unit (no date). Available at: http://www.senacare.com accessed 22 January 2017.
18. LifeBot® Product information. Available at: http://www.lifebot.us/products/ accessed 15 January 2017.
19. Avizia Tactical. Product Specifications. Available at: https://www.avizia.com/wp-content/uploads/2015/02/AVZ-TAC-DOC-DS-02.pdf accessed 25 January 2017.
20. World Health Organization (WHO). (2011). Compendium of new and emerging technologies that address global health concerns 2011. Available at http://www.who.int/medical_devices/en/index.html accessed 16 January 2017.
21. Sachpazidis I. Image and medical data communication protocols for telemedicine and teleradiology (Doctoral dissertation, Technische Universität 2008).
22. Itelmedicine. New Portable Telemedicine Videoconferencing Kits from DigiGone Provide Medical Lifeline for Remote Locations. Available at: http://itelemedicine.com/news/telemedicine-videoconferencing/ accessed 30 January 2017.