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Teleradiology Services in Disaster Events – What does exist and What is required?

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Abstract

Introduction: This study assessed the current status and need for teleradiology services in the Pacific nations following natural disasters.

Methods: Two standardised interview questionnaires were used to a) obtain current radiology capabilities and needs for teleradiology, and b) to explore how teleradiology would fit into existing regional disaster planning framework. Both questionnaires were administered between August to October 2015 to respondents in Fiji, Samoa and Papua New Guinea. The head radiologists within the major public tertiary hospital and the risk management officers within the ministry of health in these countries were interviewed over the phone or via video-conferencing. Interviews were also held with the regional coordinators of the World Health Organisation and a representative of the National Critical Care and Trauma Response Centre, the governmental agency responsible for the deployment of the Australian medical assistance teams.

Results: The interviews revealed that, teleradiology services are currently not being utilised during disaster and non-disaster times, despite respondents expressing the need for such services. There was a consensus about the perceived barriers to implementing teleradiology services, including the lack of adequate skills and training, the lack of adequate infrastructure and the ability to effectively transmit imaging data.

Conclusion: Based on the results of the needs assessment, the authors argue that there is a need for the development of teleradiology services during both disaster and non-disaster periods in the Pacific nations. The authors outline three key elements required to facilitate the provision of teleradiology services during disaster events and overcome the perceived barriers. Further research is required regarding how to practically establish these required skills and technical capabilities to support a regionally based approach to teleradiology services in the Pacific region during disaster events.

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Introduction

Telemedicine – broadly described as the delivery of health care services, where distance is a critical factor, for all health care professionals using information and communication technologies – has been a growing area in health care delivery [1]. The strategies employed during routine telemedicine encounters can and have in the past been adopted as part of the medical response to emergencies and disasters [2-6].

Radiology in particular supports a wide range of medical disciplines, including surgery, emergency medicine and general practice, providing the means to accurately diagnose and monitor conditions. Teleradiology – the ability to transmit digital imaging from one location to another using a data communication link provided by a third party carrier – has particular relevance as part of the overall medical response to man-made and natural disasters [7]. According to the World Health Organisation, a disaster is 'an occurrence disrupting the normal conditions of existence and causing a level of suffering that exceeds the capacity of adjustment of the affected community' [8].

A literature review revealed that while teleradiology has previously been used for non emergent disease screening in resource limited countries [9,10], limited knowledge exists about the use of teleradiology in disaster events with only a small number of studies describing its use by the American military [2,3,11].

With the Pacific nations being the most disaster prone region globally according to the 2015 World Risk report [12] this article presents the key findings of a recent needs assessment study

Table 1: Overview of country specific parameters.

Criteria	Fiji	PNG	Samoa
Population	886, 450 [14]	7.3 million [15]	193,483 [16]
Proportion of population living in rural regions	49% [17]	87% [15]	81%[16]
Number of tertiary hospitals	3	1 national referral	2
Radiologists (including trainees)	10	8	2
Radiographers	80	107	11
Sonographers	70	2 (12 trainees)	3
Sufficient electricity back up available?	Yes	Yes	No
Internet connection	Restricted broadband	Unstable	Restricted broadband
Teleradiology facilities /plans for disasters	No	No	No

Table 2: Overview of existing technical equipment.

Technical equipment	Fiji	PNG	Samoa
CT scanner	3	2	2
Plain film	30	22	4
Ultrasound	40	44	9
Digitisation	CT, Ultrasound, X-ray	CT and Ultrasound	CT and Ultrasound

conducted with input from Fiji, Samoa, Papua New Guinea (PNG) and the Word Health Organisation (WHO).

The aim of the study was to establish a clear understanding of the current status and needs to inform a coordinated approach in establishing a suitable teleradiology model within the Pacific nations that remains functionaland efficient during times of natural disaster.

The research was undertaken in collaboration between Radiology Across Borders [13], a not-for-profit organisation based in Australia that provides radiology education to clinicians in the Asian-Pacific region, the World Health Organisation and local health and government representatives.

Methods

A literature review was completed by performing a systematic search of the MEDLINE database for the key terms 'radiology', 'teleradiology', 'disaster' and 'disaster medicine'.

The explorative interview study used two standardised interview questionnaires to a) obtain current radiology capabilities and needs for teleradiology, and b) explore how teleradiology would fit into existing disaster planning.

Both questionnaires were administered between August to October 2015 to respondents in Fiji, Samoa and PNG. These countries were chosen due to pre-existing relationships between these countries and Radiology Across Borders and were considered a good representation of the region.

The head radiologists of each of the major public tertiary hospitals and the risk management officers within the ministry of health in these countries were interviewed over the phone or via video-conferencing. Interviews were also conducted with the regional coordinators of the World Health Organisation and a representative from National Critical Care and Trauma Response Centre (NCCTRC), the organisation responsible for the deployment of the Australian Medical Assistance Teams (AUSMAT). These teams have recent experience during deployments to Philippines in 2013 during cyclone Haiyan and Vanuatu in 2015 in the aftermath of cyclone Pam.

All potential participants who were approached for the interviews agreed to participate, which may have been the result of earlier conversations about the aims of the research that took place between Radiology Across Borders, the WHO and the respective participants.

Interview responses were correlated and analysed to compile country specific profiles and to identify common issues across countries.

For this study, no ethics approval was sought, as the data obtained in interviews is of technical and procedural nature and does not involve any individual patient-related information.

Results

The data outlined in table 1 reveals that the population of these three Pacific countries is relatively small and the majority of people live in rural areas [14-17]. There are a small number of tertiary hospitals with multi-modality radiological equipment, mainly in the capitals and some at regional centres.

The number of radiologist ranges from an average of 1 radiologist serving 90,000 people in Fiji to 1 for over 900,000 people in PNG, which compares to 1 radiologist for 8,700 people in Australia and New Zealand [18,19]. The interviews with the participating radiologists lasted between 30 minutes and one hour and revealed that currently, apart from an occasional image exchange with New Zealand for advice, there are no teleradiology services established in non-disaster or disaster periods.

All respondents expressed a strong desire for teleradiology services during both disaster and non-disaster periods. In particular, there was a need for obtaining second opinions and, with increasing patient numbers during disasters, for direct reporting of scans by overseas radiologists to ease the workload and prevent delays.

Given that teleradiology facilities do not exist in routine health care delivery in these countries, it is not surprising that, according to the respondents, there are no plans to utilise teleradiology in disaster events.

The main barriers to establishing a teleradiology service that

respondents identified were limited funding, restricted and unstable Internet access and inadequate transmission speed, as well as a perceived lack of support from within the relevant hospitals. Further, there appear to be issues with reliable electricity back up to run radiological equipment, which is particularly relevant in disaster events.

It is also noted that the Pacific nations are geographically unique in that a high proportion of the population live in rural areas, and the countries mainly consisting of a great number of small islands, with access to these islands often being very limited.

The interviews with the disaster risk management officers of the relevant ministries of health and the regional WHO coordinators revealed their support to establish teleradiology services. Similar to the radiologists' perspective, they cited limited funding, inadequate Internet connections and transmission of data as main barriers.

The Ministry of Health representatives raised the issue that any foreign medical teams could only assist upon being approached or invited to help in disaster responses. In addition, any foreign medical teams in the future will likely be required to prove the currency of practice in their country of origin as part of the WHO global health cluster foreign medical team initiative [20].

The WHO participants of the research in particular had a strong desire to set up telemedicine capabilities initially, which would then facilitate teleradiology services as a specialised sub-set. They singled out the lack of adequate telemedicine and teleradiology services as one of WHO's current major limitations across the Pacific nations when responding to disaster events.

Discussions with the NCCTRC representative revealed that they currently have the ability to provide basic mobile bedside ultrasound and x-ray when deployed during disaster events. Currently a radiographer travels with the team to perform plain x-rays and all ultrasounds are performed and interpreted by the deployed emergency physicians. Plain x-rays are used predominantly for skeletal trauma and the ultrasound is limited to time critical bedside interpretation. Based on this limited use of radiology with the deployment there was a limited desire for Teleradiology services at the present time although it recognised that this would be a useful addition in the future.

Discussion

Radiological capabilities in the majority of the Pacific nations remain relatively basic when compared to the Western world. CT scanners are uncommon and non-existent in many Pacific nations although this is slowly changing. Even basic imaging modalities such as x-ray and ultrasound are prone to interpretation error without the appropriate training that can lead to patient morbidity and mortality. Teleradiology can facilitate specialist review of imaging in a country that otherwise has no, or limited access to these skills. The increased number of presentations and complexity of illnesses during disaster events means the limited capabilities of these nations is further strained and external support is even more vital.

This study has identified that there are currently no regular Teleradiology services operating within the Pacific region despite a desire to establish these services. The establishment of Teleradiology services could act to both support existing local services during non-disaster times while also providing increased support when required during natural disasters. Additional benefit includes the ability to support the limited radiological capabilities of the deployed foreign medical teams during disaster events. There appears to be consensus across radiologists, health ministries and the World Health Organisation about the main barriers that currently exist at a local level, which can be summarised as inadequate skills, a lack of technical capabilities and infrastructure, and potentially high costs. Geographical barriers must also be considered as the Pacific nations have a relatively unique landscape often with each Pacific nation consisting of hundreds of smaller islands and most of the population living in rural areas.

Teleradiological services must fit within the existing disaster response plan. Currently disaster management in the Pacific region is a regionally coordinated approach with collaboration between government and non-government bodies (WHO, NGO's). Telemedicine and Teleradiology remain underdeveloped or absent within the current disaster response planning.

Based on the results of this study and a review of the literature citing experiences in other regions the authors outline three key components required to facilitate the provision of Teleradiology services in the Pacific nations during both disaster events and non-disaster periods and overcome the perceived barriers. These components require further investigation and include:

1) Review of existing infrastructure and/or provision of new radiological infrastructure in addition to providing appropriate training in its operation.

a. Existing equipment must be functional and able to produce diagnostic quality images.

b. If there is a significant lack of infrastructure in a region this must be sourced and funded.

c. Reliable electricity supply is vital immediately following a disaster event and therefore adequate access to back-up electricity must be available.

d. Training of staff in order to operate the radiological equipment and produce diagnostic quality images. This can be performed through online lecture series and hands on training during site visits by organisations such as Radiology Across Borders.

2) Ability to obtain, store and transfer images to an external source such as a laptop.

a. If radiographic films are used then an appropriate flatbed scanning technology is required to digitize these films. If CR or DR systems are in place images need to be transferred to a computing device by cable, USB or wireless connection.

b. Appropriate devices such as laptops may need to be funded.

3) The ability to transfer this information in a secure fashion to a remote location in order for specialist review and interpretation in a reasonable time frame.

a. Transfer of data remains an important barrier following a disaster event and discussions have already commenced with organisations such as Telecoms Sans Frontieres who have experience in this field. Satellite transmission, Broadband Internet or cellular data each present their own benefits and limitations. Satellite provides relatively stable connection during disaster events although the cost, transmission speed and available bandwidth can be limitations. Cellular data networks may remain functional during disaster events or be repaired within the first few days and so any infrastructure

capabilities developed should be capable of connecting to the cellular network.

b. A password protected web based platform for viewing images remotely needs to be adapted or developed. Organisations such as Médecins Sans Frontières already utilise a telemedicine platform made by Collegium Telemedicus [10].

c. Available radiology specialists must be available to view these images and provide a report or second opinion in a reasonable time frame.

The development of teleradiological capabilities in these regions could drive further investment and development in the current radiological infrastructure both at a local level and accompanying the deployed foreign medical teams. With specialist support, an increased number of mobile ultrasound and x-ray machines could be deployed along with trained radiographers in addition to support for more advanced imaging modalities such as CT.

Given the low level of existing radiological skills and technical infrastructure in many of the Pacific nations, further benefits include the opportunity to establish common radiological standards in a regionally coordinated approach, that brings together the World Health Organisation, local governments, health administrators and clinicians; as well as international NGO's, such as Radiology Across Borders and the Red Cross.

The strong desire for non-disaster day-to-day teleradiology service among respondents suggests that relevant training and establishment of adequate infrastructure for teleradiology services could have benefits for the overall quality of health care beyond the enhanced capability to manage disaster events. The fact that the majority of the population lives in rural areas appears to support such an approach.

Although the study size was small, and would not support generalisation of results across all Pacific countries, the 100% response rate may indicate the extent of the need of teleradiology services in this area. Among respondents, there was a strong consensus about both the need for such services and the identified barriers. Building on the results of the needs assessment, further research is required into the options of how to practically establish the required skills, technical capabilities and coordinated communication to support teleradiology services in the Pacific region during disaster events.

Conclusion

Based on the results of the needs assessment, the authors argue that there is a need for the development of teleradiology services during both disaster and non-disaster periods in the Pacific nations. The authors outline three key elements required to facilitate the provision of teleradiology services during disaster events and overcome the perceived barriers. Further research is required regarding how to practically establish the required skills and technical capabilities to support a regionally based approach to teleradiology services in the Pacific region during disaster events.

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