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The UK medical response to the Sichuan earthquake

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ABSTRACT

Background At 14:48 on 12 May 2008 an earthquake of magnitude 8.0 struck the Wenchuan area of Sichuan province, China. A decision to offer/receive UK medical assistance was agreed at a Sino/British political level and a medical team was despatched to the earthquake area.

Methods This study describes the team's experience during the immediate aftermath of the earthquake and the following 18 months, during which there have been joint developments in emergency medicine, disaster planning/preparedness and the management of spinal cord injury.

Results The long-term disability following sudden onset natural disaster and the wider impact on healthcare delivery may prove to be a greater burden to the country than the immediate medical needs, and, accordingly, emergency international aid may need to widen its focus. Although international teams usually arrive too late to support resuscitative measures, they can respond to specific requests for specialised assistance, for example plastic and reconstructive surgery to assist with the ongoing management of complex injury, relieve those who have worked continuously through the disaster, and when required maintain routine day-to-day services while local staff continue to manage the disaster. The timing of this does not necessarily need to be immediate.

Conclusions To maximise its impact, the team planned from the outset to build a relationship with Chinese colleagues that would lead to a sharing of knowledge and experience that would benefit major incident responses in both countries in the future. This has been established, and the linkage of emergency humanitarian assistance to longer term development should be considered by others the next time international emergency humanitarian assistance is contemplated.

INTRODUCTION

At 14:48 on 12 May 2008 an earthquake of magnitude 8.0 struck the Wenchuan area of Sichuan province, China.¹ The affected population was 46.24 million, spread over 10 provinces involving 417 counties, 4667 towns and 48 810 villages. Ultimately 15.1 million people have required resettlement. Half (10243/19698, 52%) of all health facilities were destroyed or damaged. There were at least 69 207 people killed, with a further 18 194 reported missing 3 weeks later. There were 374 216 people injured by the earthquake, almost 100 000 of whom were hospitalised (26.7%).² Medical staff in the most affected areas of Wenchuan, Lixian, Maoxian, Pingwu and Qingchuan treated 28 340 injured patients in 72 h. Two thousand four hundred and eighty-three people died in hospital, accounting for 2.5% of the total number hospitalised.

The decision to offer/receive UK medical assistance was taken at a Sino/British political level and

the UK Foreign and Commonwealth Office funded the immediate response. The request to the medical team came through 3 days after the earthquake and the team were in country 48 h later. This study describes the team's experience during the immediate aftermath of the earthquake and the following 18 months.

THE CHINESE RESPONSE

Local emergency services responded within a few minutes, with a countywide response within 30 min. Within 6 h of the earthquake, 147 medical rescue teams (714 persons) were at the epicentre and further teams reached less affected areas within 12 h, rising to 1424 first line medical staff on scene by 24 h.

Thirty-one medical teams from outside the Province of Sichuan were mobilised, arriving on scene 24–48 h after the 'quake. By the third day there were 4880 Chinese personnel from outside Sichuan at work in the earthquake area.

Teams from other countries (Taiwan, Russia, Hong Kong, Japan, Italy, Macau, Germany, Cuba, UK, France, USA) began arriving in China on 15 May and stayed until 7 June. Chinese authorities monitored their input and reported that they treated 24 410 cases at 11 sites in Sichuan, carrying out 629 surgical operations (1.7% of total). They provided nursing to 3204 patients and did 3072 clinical rounds. They provided 377 consultations to Chinese colleagues and trained 2767 staff over 73 sessions. They set up three mobile hospitals, where 1901 patients were treated.³

Some of the affected areas were very remote mountainous areas and it was 10 days after the earthquake before medical support could be helicoptered into the villages of Genda, Sanjiang, Yingxin and Caopo in Wenchuan County.

In all, medical teams were dispatched to 950 villages in 67 counties and 11 major cities.

A regional and national response was clearly effected immediately, coordinated from Beijing and utilising in particular the significant technical and personnel resources of the Peoples Liberation Army. Because of the degree of damage to hospital infrastructure and the scale of the casualty load, the rapid onwards transfer and distribution of patients from one medical centre to another, at times over hundreds of miles, was a special feature of the response. Within 40 min of being injured, the first patient from Pengzhu arrived at Sichuan Provincial People's Hospital in Chengdu. By 12 h after the earthquake, over 3000 injured patients had been transferred to the Sichuan Provincial People's Hospital, West China Hospital, Deyang Municipal People's Hospital, Mianyang City People's Hospital and Guangyan Municipal People's Hospital. From the fifth to the nineteenth day after the earthquake,

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10373 patients (10.5% of admissions) were transferred to 367 hospitals in 58 cities across 20 provinces and municipalities using 21 special trains and 99 chartered flights. Over 5000 medical staff and over 9000 family members accompanied patients during their transfer. This was the greatest long-distance peacetime transfer of wounded patients in China (and possibly in the world).²

When the nearest major hospital to the epicentre in Mianyang received further damage in an aftershock, patients were transferred as far as Beijing – 37 h by train.

This wide distribution of critically injured patients followed what the Chinese authorities have described as the principle of ‘Four Concentrations’: concentration of patients, concentration of experts, concentration of resources and concentration of treatments. How this was applied in practice was difficult to determine from the information that was made available to the authors, but it was clear that no one hospital or facility was overwhelmed by such radical triage, with the functioning of the overall system maintained at a potential cost to an individual patient. A trade-off between the greater good and the individual is at the heart of mass casualty triage, although there were no deaths or ‘additional injuries’ recorded in transit.²

THE WORK OF THE UK TEAM Immediately post earthquake

Published and personal experience^{9 10} dictated that peripheral limb injury and skin closure would be the principal problems by the time the team arrived in China, and a plastic/reconstructive and two orthopaedic surgeons formed the core of the initial team. These were supported by two emergency physicians and an emergency nurse consultant who could triage patients, provide immediate care and treatment, and assist in the operating theatre. Anaesthetic support was provided by local anaesthetists. An epidemiologist with current experience of working in China completed the team.

As expected, peripheral limb injuries were the most common injury encountered,⁴ in keeping with the usual pattern of injury seen in survivors of major earthquakes.^{5–7}

The team began work in Mianyang, the nearest hospital to the epicentre that had functioning surgical facilities. They reviewed with Chinese colleagues over 50 cases, either immediately post surgery or to plan later staged procedures. On day one, for example, the team carried out ORIF (open reduction and internal fixation) of the distal femur, manipulation and stabilisation of a calcaneal fracture, reduction and fixation of a fracture dislocation of the hip and debridement of a compound fracture of the tibia and fibula (figures 1 and 2).

Guillotine amputations had been carried out in a number of cases and stump revision was required (figure 3).

While carrying out exploration of a complex knee injury involving nerve damage, a 6.4 aftershock struck, damaging further the building in which the team were on the 10th floor. Surgery had to be temporarily abandoned while the patient was evacuated to an outside field hospital.

The aftershock added further to concerns about ‘quake lakes’ above Mianyang bursting their banks and flooding the city. It also added significant further damage to the surgical building. These factors meant that the team had to eventually transfer its activities to the provincial capital Chengdu where they worked in the Second Peoples’ Hospital.

While the team were in Mianyang, one of the authors (ADR) held meetings with Public Health Officials from Beijing to discuss public anxieties about epidemics. To allay fears, particularly about the unburied dead, a public meeting, led by ADR



Figure 1 Field hospital in grounds of Mianyang Hospital where UK team first worked.

and the team’s epidemiologist, was held in the hospital where these issues were discussed.

There were two major complex orthoplastic reconstructions carried out by the UK team on arrival in Chengdu, each involving the foot and ankle. Further surgery involved external fixation of several lower limb fractures, skin grafting areas of tissue loss and wound debridement. Because of the greater number of local surgeons in Chengdu, the team usually worked alongside Chinese colleagues. One day was spent in a joint clinicopathological conference with Chinese colleagues, reviewing the management of all cases they had treated from the earthquake and discussing their onward management (figure 4).

Another day was spent reviewing major incident procedures and comparing emergency medicine in the UK and China. This laid the foundation for the Sino/British cooperation in emergency medicine and disaster planning that followed.

PATTERN OF INJURY

Individual hospitals have published data, but the scale of the disaster, the number of institutions involved and the widespread distribution of casualties has meant that there has been no



Figure 2 Mr Toby Branfoot and Mr Waseem Saeed carrying out orthoplastic repair of ankle while watched by Chinese colleagues in Chengdu.



Figure 3 Young girl with guillotine amputation at mid thigh that required plastic revision by the UK team.

comprehensive national data analysis. There has been a sample study of patients across three counties (Jiangyou, Mianzhu, Shifang) in Sichuan from Sep 2008 to Mar 2009 by one of the authors (JL). This identified 3324 injured persons, of whom 5.5% (183) required limb amputations, just over half of which were below knee. Traumatic brain injury occurred in 277 (8.3%).

There were 189 (0.2% of hospitalised patients) cases of spinal cord injury officially recorded after the earthquake, with 48 (25%) in these three districts. Spinal cord injuries were mostly at thoracic level and below, indicating that patients with higher lesions generally died before or shortly after rescue. This pattern was repeated in other centres.⁸

Crush syndrome was reported in 17 cases (0.51%). However, in Chongqing, to where many patients had been transported, the incidence was 3.9%.⁴

Severely injured patients have required prolonged rehabilitation and community-based rehabilitation was required in remote areas. As in many countries, rehabilitation capacity is very limited in China, with at least 6000 earthquake-injured patients in the province with limited or no access to rehabilitation services.

SUBSEQUENT ACTIVITIES

Before leaving, the team held discussions with Chinese colleagues on how they could build on their new relationship and draw out lessons from the response to the earthquake. The result was a successful joint Sino/British proposal to the UK Department for International Development (DFID) to support cooperation in emergency medicine, disaster planning/preparedness and the management of spinal cord injury.



Figure 4 Mr Waseem Saeed addresses Chinese surgeons on the management of complex upper limb injuries.

- ▶ In February 2009, a 1 week Sino/British Conference on Emergency Medicine, Disaster preparedness and Spinal Cord injury was held in Chengdu. The faculty was drawn from Chengdu, Nanjing, Beijing and UK, with UK funding also used to support the attendance of Chinese delegates from the more remote areas. This team included those who had attended after the earthquake plus a public health specialist to address the issue of the real versus the perceived risk of infection after earthquake and four specialist staff from the Midlands Spinal Injury Centre, Oswestry. During this time, the UK team revisited the earthquake area and observed the rapid scale of rebuilding (figure 5).
- ▶ In May, five senior UK medical students were seconded to establish academic links between the Nanjing Medical University and Manchester Medical School. This has led to an ongoing exchange and Manchester medical students able to spend part of their course at Nanjing Medical University.
- ▶ Three doctors from Beijing and three doctors from Chengdu were funded to attend Prehospital Paediatric Life Support, Major Incident Medical Management Support (MIMMS) and Advanced Trauma Life Support courses in the UK during September 2009. This was part of the process of developing and adapting these types of courses for China.
- ▶ Further Sino/British conferences on hospital major incident planning and the introduction of MIMMS courses into China were held in Chengdu and Beijing during December 2009.
- ▶ In 2010 a modified 'MIMMS for China' will be developed and rolled out across China.

OBSERVATIONS

Infection

There was considerable national and local concern over epidemic outbreak,¹¹ in spite of cumulative evidence from other similar events that epidemics are, in fact, uncommon after sudden-onset natural disasters.^{12 13} It is the mass movement of people into unsanitary conditions that poses the greatest risk, rather than the immediate effects of the earthquake itself. The Chinese authorities addressed this latter aspect extremely well, with temporary accommodation erected swiftly and competently. Nevertheless, although the overall risk of epidemics after sudden-onset natural disaster is low, the background risk of infectious disease in this particular area was already relatively high. For example cholera had recently been reported in Sichuan prior to the earthquake, with diarrhoea alone accounting for 12% of deaths in under fives in China at that time.¹⁴ Given this degree of background vulnerability, the extensive efforts of the



Figure 5 Faculty of first Sino/British Conference of Emergency Medicine, Disaster Preparedness and Spinal Cord Injury.

Centre for Disease Control were not unreasonable, not least to appease public concern. In fact, the overall incidence of infectious disease in the earthquake area actually fell in the months that followed compared to the year before.¹⁵ The wide-scale emergency public health measures may have addressed underlying infectious risks, perhaps as well as, or even instead of, the perceived risks of the earthquake.

A fear of infection was present in hospitals where there was a uniformly held but incorrect belief that gas gangrene could be transmitted between patients in hospitals.^{4 16} When no cross-infection occurred, this was taken as confirmation that isolation measures had proved to be effective.⁴

There was considerable anxiety among the public, and also within the medical community, about the threat to health of the unburied dead, both human and animal.^{17–19} Such fears are widely held across most countries but largely unfounded. Such beliefs and fears are not harmless. They can (and at times did) lead to an unnecessary rush to mass or unmarked graves, with all the anguish and uncertainty this gave to loved ones.

Spinal cord injury (SCI)

Spinal cord injury with neurological deficit is a feature of earthquakes,²⁰ and was a feature of the Wenchuan earthquake.⁸ However, in spite of the extremely large scale of this disaster and the very high number of casualties, the total number of SCI patients recorded was 75% fewer than that reported in the Bam earthquake and less than a third of that reported in Pakistan.²⁰ Given the magnitude of the shock and the size and population density of the area affected, this suggests under-reporting, a higher immediate death or both. Whatever the number, the rehabilitation of SCI is costly and China was already struggling to meet the requirements of its 60 000 new cases each year.²¹ The newly introduced copayment programme for health services was temporarily suspended for earthquake victims, which only served to emphasise the immense financial burden of chronic disease and disability on a country of over 1.3 billion people.

Crush injury

The reported incidence of crush syndrome in hospitalised patients was less than reported in some recent urban earthquakes,^{22 23} and, if not under-reported, may reflect the overall timeliness of the rescue and effectiveness of early treatment.

Amputation

The amputation rate of 5.5% seen in the study of three counties was matched by the 6.0% amputation rate seen in Chongqing hospitals.⁴ Amputation rates after earthquake vary. In Bam, published reports indicate a range from 0.4%–2.9%^{24 5} for some hospitals, but rates as high as 10.8%⁶ were indicated for patients treated in tertiary hospitals. Reports from the Kashmiri earthquake reveal rates of 0.6%–3.6%^{25 26} recorded in some hospitals. The amputation rate in China does not appear to have been unduly high.

Patient transfer

In spite of the enormous number of casualties, the radical distribution and transfer of patients successfully ensured no one institution was ever overwhelmed. However, there are limited data to clarify whether additional sieves were implemented to ensure this was always accompanied by appropriate immediate interventions. It was evident, however, that an established national major incident programme was put into practice very quickly; this will be strengthened by the incorporation of

advanced triage protocols at a more local level, such as taught on the MIMMS courses.²⁷

International medical assistance

Given the scale of the disaster and the capacity and experience of Chinese medical services, the potential for international medical teams to have had a significant influence on the overall mortality/morbidity was limited. However, there are always ethical implications in responding to, or ignoring, a clear request for assistance. Arriving unannounced at the scene of a disaster in a foreign country might only compound an already difficult situation, but heeding a call to help and working alongside those in need, can provide practical and professional support to colleagues overseas that will serve as a vehicle for future cooperation and understanding. The timing of the request and the time in transit meant that the team was not on the scene until 5 days after the earthquake. Although too late for resuscitative work,^{28–30} it was unlikely to be too late to support reconstructive/staged surgery and to give technical support based on previous experiences.

CONCLUSION

The team members were aware from the outset that in this particular disaster their clinical impact in terms of the number of patients treated would most likely be limited. However, there had been a clear request by the Chinese authorities for UK support to which the team felt ethically obliged to respond and hoped by showing support in a time of need to strengthen Sino/British medical relations. To broaden its impact beyond immediate patient care, the team planned from the outset to provide wider technical support and build a relationship with Chinese colleagues that would lead to a sharing of knowledge and experience that could benefit major incident responses in both countries in the future. It is believed that this has been achieved. Among many exchanges of ideas and experiences, the UK team saw at first hand the benefits of a well-executed national disaster plan with a wide distribution of patients to prevent hospital overload, and through a series of subsequent seminars and exchanges the Chinese have learned the benefits of strengthening the individual hospital response.

It is recommended that the linkage of emergency humanitarian assistance to longer term development and cooperation should be considered by others the next time international emergency humanitarian assistance is contemplated.

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