Editorial

The Record-Setting Flood of 2014 in Kelantan: Challenges and Recommendations from an Emergency Medicine Perspective and Why the Medical Campus Stood Dry

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Abstract

Floods are considered an annual natural disaster in Kelantan. However, the record-setting flood of 2014 was a 'tsunami-like disaster'. Hospital Universiti Sains Malaysia was the only fully functioning hospital in the state and had to receive and manage cases from the hospitals and clinics throughout Kelantan. The experiences, challenges, and recommendations resulting from this disaster are highlighted from an emergency medicine perspective so that future disaster preparedness is truly a preparation. The history of how the health campus was constructed with the collaboration of Perunding Alam Bina and Perkins and Willis of Chicago is elaborated.

Keywords: *floods, natural disaster, emergency medicine*

Introduction

Floods are an annual occurrence of varying severities in Kelantan state on the east coast of Peninsular Malaysia. They also affect its neighbouring states, specifically Terengganu and Pahang. Previous floods, including those of 1927 and 1967, were considered significant in Kelantan's history. The 1967 flood had a major impact on the Kelantan population; it has been estimated that 70% of the kampungs (villages) in Kelantan, or nearly half of the state's population, were affected (1). The 2014 flood was the most significant and largest recorded flood in the history of Kelantan. It was considered to be a "tsunami-like disaster" in which 202,000 victims were displaced (2). This flood was called 'Bah Kuning' (yellow-coloured flood) because of its high mud content (3,4).

Chronology of the Flood

Torrential rains that began on the 17th of December, 2014, led to flash flooding and forced 3390 people in Kuala Krai, Kelantan, to flee their homes (5). Later, three days of continuous heavy rain fell from the 21st to the 23rd of December, 2014, in Gua Musang. This was a record-setting rainfall of 1 295 mm, equivalent to the amount of rain usually seen in a span of 64 days. As a result, the water levels of three major rivers, the Sungai Galas in Dabong, the Sungai Lebir in Tualang and the Sungai Kelantan, rose drastically above the water levels considered dangerous (6).

The highest recorded level of the Sungai Galas in Dabong, GuaMusang was 46.47 metres (danger level: 38 metres), the highest recorded level of the Sungai Lebir in Tualang, Kuala Krai was 42.17

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metres (danger level: 35 metres), and the highest recorded level of the Sungai Kelantan was 34.17 metres at Tangga Krai, Kuala Krai (danger level: 25 metres) and 22.74 metres (danger level: 16 metres) at the Guillemard Bridge in Tanah Merah. The highest level of the Sungai Golok at Rantau Panjang was 10.84 metres, which was over the danger level of nine metres (7) (Figure 1–7).

Emergency Medicine Experiences and Challenges

Disaster medicine (DM) is a medical specialty, meaning that any medical doctor can pursue it. However, emergency physicians (EPs) are often required to play key roles in disaster management (8). The most important topics in this specialty include disaster mitigation and preparation, as well as the creation of a properly designed and effective disaster response and recovery plan. This is essential to minimising physical and psychosocial casualties.

Unlike other flood disasters that had many casualties (9) and deployments of medical relief teams, 'Bah Kuning' in Kelantan resulted in minimal casualties, with only 13 deaths recorded (7), and no relief teams were deployed from Hospital Universiti Sains Malaysia (HUSM). However, there was a surge of patients at HUSM due to the closure of a nearby hospital, Hospital Raja Perempuan Zainab 2 (HRPZ2). In fact, the only available tertiary centre for all of Kelantan was HUSM (10). There was an influx of patients who presented to HUSM after HRPZ2 closed on the 25th of December, 2014. Those cases were generally acute problems from underlying chronic medical conditions such as acute coronary syndrome, acute exacerbation of chronic obstructive airway disease, heart failure, sepsis, and other diseases. Table 1 displays the number of cases that presented to the ED at HUSM during the disaster. The average number of cases that

Figure 1: Kelantan Football stadium was filled with floodwaters.

Figure 2: Property damaged: Cars were submerged in the floodwaters.

Figure 3: This aerial view shows houses and plantations submerged in floodwaters in Pengkalan Chepa, near Kota Baru, Kelantan on December 28, 2014.

Figure 4: Houses and plantations submerged in the floodwaters.

presented to the Emergency Department (ED) at HUSM was 180 cases/day. Although the number was not as high as most government hospitals, patients who presented to the ED at HUSM were managed effectively. Most of the procedures were performed by ED residents, including bedside ultrasounds, central line insertions, and chest tube insertions, until diagnoses were confirmed or patients were stable. Access block became an issue because all referral cases must be reviewed in the ED by their receiving departments and because it was not uncommon for beds to be unavailable. Some of the patients were managed in ED for more than 24 hours. These patients had to be monitored and reviewed regularly, particularly those in the red zone.

Figure 5: Firemen rescued flood victims during the disaster.

Another challenge that was encountered during the disaster was a shortage of staff. Almost 50% of the staff was affected by the floods, including the head of the Emergency Department. Furthermore, there was no disaster declaration from the top-down at HUSM on day 1 of the disaster, meaning that the ED staff had to handle the situation themselves. With the increasing number of patients, this became a disaster for them. Luckily,a group of medical students was proactive in assisting the staff and managing the triage counter, clerking patients in the green zone and controlling the crowd in the waiting area (10). Their services during the event were commendable, and many of the staffs in ED were taken aback by their initiative.

HUSM also received patients who were transferred by helicopter. The medical evacuation

Figure 6: Tsunami-like disaster damaged the cars.

Figure 7: Property damaged: House on a house.

Table 1: Number of cases based on zone presented to Emergency Room Hospital Universiti Sains Malaysia

Day	Date	Red zone	Yellow zone	Green zone	Total
1	25th December 2014	21	82	149	252
2	26th December 2014	13	94	146	253
3	27th December 2014	25	105	153	283
4	28th December 2014	29	149	203	381
5	29th December 2014	19	103	123	245
6	30th December 2014	12	92	114	218
7	31st December 2014	12	71	121	204

(medevac) involved 137 cases from district hospitals and clinics (Pejabat Kesihatan Daerah) (Table 2). Most of the patients were critically ill and required ventilator support. Five cases were transferred direct to Hospital Besut in Terengganu for continuation of critical care because the critical care units at HUSM were fully occupied. Hospital Kuala Krai had the largest number of patients being medevac.

Volunteers began to arrive in Kelantan on the 28th of December, 2014. Most of the volunteers were healthcare providers from universities and the Ministry of Health. A total of 261 volunteers registered with the Volunteer Operations Office (Bilik Gerakan Banjir Sukarelawan HUSM) to assist with the administration of healthcare services. However, some of them had to go to the district area, along with Jabatan Kesihatan Negeri (JKN) Kelantan and MERCY Malaysia. Table 3 displays the total number of volunteers and their affiliations. Coordinating the volunteers with all of the departments in HUSM and JKN Kelantan was also a challenge during the disaster.

Recommendations

Medical management during any disaster must be coordinated by the individuals or organisations most experienced and knowledgeable in disaster management and should not be based solely on the most senior person in an organisation. In our recent experience during the worst recorded flood disaster in our country, both the out-of-hospital and in-hospital disaster responses had to be activated due to the phenomenal scale of the flooding because it affected more than half of the city and state area. Regardless of the nature of the disaster, its management must involve four phases: mitigation/prevention, preparedness, response and recovery. These phases must be well coordinated across all relevant agencies, including those in both health and non-health sectors, so that all of the activities taking place are synchronised across all of the stakeholders involved.

Disaster preparedness is the crux of flood disaster management. Recommendations from an emergency medicine perspective include the following:

- A proper flood disaster preparedness plan and training for it are important not only for emergency medicine residents but also for those working in administration. Administrators who are well versed in disaster will perform disaster management more efficiently. Orders from the top-down will improve coordination and provide moral support for the staff.
- Standard operating procedures (SOPs) need to be kept in writing for various levels of the disaster response, i.e., from the activation of it to the post-disaster phase. These SOPs must be tested and drilled with all personnel involved at regular intervals. Drill outcomes must have measurable parameters for the institution's continued development.
- An effective communication system is of paramount to the coordination of rescue and relief operations. In the present flood disaster, the main network was disrupted

Table 2: Number of medevac cases during the disaster

Date	Hospital Kuala Krai	Hospital Tanah Merah	Hospital Tumpat	Hospital Gua Musang	Hospital Pasir Mas	PKD Kuala Krai*	PKD Pasir Mas	PKD Kota Bharu	Total
25th Dec	3	0	0	0	0	0	0	0	3
26th Dec	35	0	0	0	0	0	0	5	40
27th Dec	15	2	11	0	8	6	2	0	44
28th Dec	10	1	2	1	3	4	0	9	30
29th Dec	18	0	0	0	0	1	0	0	19
30th Dec	0	0	0	1	0	0	0	0	1
Total	81	3	13	2	11	11	2	14	137

*including retrieving patients who were stranded in patients' house in Kuala Krai, Sekolah Menengah Kuala Krai and evacuation centres (Kemubu and Manik Urai).

extensively in almost all of the district's hospitals. Thus, it is crucial to establish an alternative communication system to handle such emergencies efficiently and effectively. The chain of command within this communication system should be tested from time to time.

- Disaster management is a multidisciplinary activity involving all departments in the hospital. All of the departments should be actively involved in managing cases. Teamwork and flexibility between departments are essential.

Table 3: Volunteers from MOH and universities came to Kelantan to help the healthcare services in HUSM and JKN Kelantan

Center Origin	No	Doctor	Paramedic/ Radiographer assistant /Driver	Date of Arrival	Date of Return	Place of Duty
PPUM/UITM	50	35	14SN/1MA	28/12/2014	2/1/15	JKN
PPUKM (1)	6	2	2SN/2MA	28/12/2014	3/1/15	MERCY/JKN
HKL FORENSIC	3	3	-	28/12/2014	2/1/15	HRPZ
IPHKL	10	5	5SN	28/12/2014	9/1/15	HUSM(5) JKN(5)
IKN	5	-	5SN	28/12/2014	10/1/15	HUSM
IPPT (1)	9	-	9SN	29/12/2014	5/1/15	HUSM
PPUKM (2)	9	5	3SN/1MA	29/12/2014	4/1/15	MERCY/JKN
PAED TEAM KL	9		9SN	29/12/2014	12/1/15	HUSM(6) JKN(3)
IPPT (2)	3	-	3 JXR	30/12/2014	5/1/15	RADIOLOGI HUSM
UTHM	7	1	3SN/3DV	30/12/2014	4/1/15	DIALISIS HUSM
USM INDUK	1	-	1	30/12/2014	6/1/15	DIALISIS HUSM
PPUKM	5	3	1SN/1MA	31/12/2014	7/1/15	DIALISIS HUSM
TEAM KKM (1)	44	-	34SN/10JM	1/1/2015	10/1-14/1	HUSM(16) JKN(28)
IPPT	7	-	3DV/4TECH	2/1/2015	4/1/15	HUSM
TEAM KKM (2)	43	3	32SN/8JM	2/1/2015	10/1-16/1	HUSM(26) JKN(17)
TEAM KKM (3)	10	-	10SN	3/1/2015	10/1/15	USM
PPUKM (4)	3	3	-	3/1/2015	10/1/15	DIALISIS HUSM
UNIMAS	11	5	6SN	3/1/2015	8/1,10/1 17/1	DABONG
UNIMAS	1	1	-	4/1/2015	10/1/15	JKN
UPM	2	2	-	4/1/2015	10/1/15	DIALISIS HUSM
HOSPITAL MUAR	2	2	-	4/1/2015	5/1/15	HUSM
IPPT	18	-	13SN/2MA 3JXR	5/1/2015	12/1/15	HUSM
HSNZ	3	3	-	5/1/2015	8/1/15	DIALISIS HUSM
TOTAL	261	73	188			

Abbreviation: PPUM = Pusat Perubatan Universiti Malaya; UITM = Universiti Teknologi Mara; PPUKM = Pusat Perubatan Universiti Kebangsaan Malaysia; HKL = Hospital Kuala Lumpur; IPHKL = Institut Pediatrik Hospital Kuala Lumpur; IKN = Institut Kanser Negara; IPPT = Institut Perubatan dan Pergigian Termaju; UTHM = Universiti Tun Hussein Onn Malaysia; USM =Universiti Sains Malaysia; KKM = Kementerian Kesihatan Malaysia; UNIMAS = Universiti Malaysia Sarawak ; UPM = Universiti Putra Malaysia; SN = staff nurse; MA = medical assistant; JXR = radiographer assistant; DV = driver; JM = community nurse (jururawat masyarakat); TECH = technician.

- If an overflow of patients occurs at the ER, all of the green zone cases should be diverted to a designated area so that more critical cases (yellow zone and red zone cases) can be managed with the appropriate standard of care. Green zone cases should be relocated to a different area so that the ER is not crowded by patients and their relatives. Using a separate disaster tent will help to control the crowd so that cases can be managed properly. These detached facilities are also important as isolation areas, especially when managing infectious disease cases.
- HUSM received a large number of patients who were transported by helicopters over the five days of the disaster. SOPs should be written to direct the flow of such patients from the helipad to the ER.
- During any disaster, a sudden influx of both healthcare and non-healthcare volunteer workers should be expected. Protocols need to be in place to manage and coordinate these volunteers so that manpower specialties are channelled to specific areas in the best possible way. This is also true of managing incoming medical equipment and drugs during a disaster.
- Effective human resources management is essential to ensuring adequate staff capacity and continuity of operations during a disaster. Hospital staff contact lists should be regularly updated. Ensuring adequate staff for shift rotations and caring for their welfare aids in supporting morale and reducing medical errors.
- Flood-prone areas and supply roads should be mapped manually or using geographical information systems with overlying existing healthcare facilities to identify unaffected areas and clinics/hospitals. This is important for placing pre-planned medical equipment at strategic sites for swift mobilisation to flooded areas.

Because no one can guarantee that the record-setting flood of 2014 will not recur in 2015 or thereafter, disaster mitigation and preparedness are without a doubt the best way forward.

How a Plan to Build a Medical Campus in Kelantan 35 years ago saved nearly 2000 patients

The initial year (1979–1980) of planning for the USM campus in Kubang Kerian was not without problems, as approvals for the scope of work and the appointment of building consultants (involving two failed negotiations) by the relevant authorities took time. Approval for the scope of work from the JPPN (National Committee for Planning & Development) was received in August 1980, which included an allocation for a 1200-bed HUSM. In September 1980, a special committee chaired by the Chief Secretary (KSN) made the decision to invite five local architectural firms with international partnerships to submit technical and financial proposals. Then, in November 1980, approval was received for the appointment of Perunding Alam Bina (PAB) in collaboration with Perkins and Wills of Chicago (the second top healthcare designer in the US at that time).

With this appointment, two working sessions were held with the consultants in December 1980 and January 1981 to develop an integrated, functional building to reflect the academic programme with consideration for the site's weather conditions. Their "fast track approach"

Figure 8: The 1927 floods were the worst recorded in the history of West Malaysia. (source: Muzium Negeri Kelantan).

goal for completion of the entire project was May 1985. As the project was about to be launched, the economic recession set in, necessitating rescheduling and repackaging of the project's implementation. Cost-cutting was required; the specific changes included a reduction of the 18-foot bund around the campus to 16 feet (which is still above the level of the record floods of 1927) (Figure 8). The two floors above the Operating Theatre Complex (designed to accommodate four surgical-based wards) were also removed from the project though the piling work was designed for four floors (11).

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