# Management of Diabetic Surgical Patients in a Deployed Field Hospital: A Model for Acute Non-Communicable Disease Care in Disaster

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**Conflicts of interest:** none

**Keywords:** diabetes; emergency medical teams; non-communicable disease; sudden onset disaster

**Abbreviations:**
AusMAT: Australian Medical Assistance Team
EMT: emergency medical team
FMT: foreign medical team
NCD: non-communicable disease
OT: operating theater
SOD: sudden onset disaster
WHO: World Health Organization

**Received:** August 27, 2016
**Revised:** December 21, 2016
**Accepted:** January 14, 2017

Online publication: July 27, 2017

doi:10.1017/S1049023X17006707

## Abstract

Sudden onset disasters (SODs) have affected over 1.5 billion of the world's population in the past decade. During the same time, developing nations have faced a sustained increase in the burden of non-communicable disease (NCD) with extra pressure placed on health systems. The combined increase in SODs and the NCD epidemic facing the world's most disaster-prone nations will present new challenges to emergency medical teams (EMTs) during disaster response. This report details the experience as an EMT during the Typhoon Haiyan disaster of 2013, with particular reference to the challenges of diabetic management in a surgical field hospital. The incidence of diabetes in this surgical cohort exceeded that of the population by a factor of four. The steps to prepare for and treat diabetes in the field provide a useful model for the management of NCD in the deployed field hospital environment after a disaster.

**McDermott KM, Hardstaff RM, Alpen S, Read DJ, Coatsworth NR. Management of diabetic surgical patients in a deployed field hospital: a model for acute non-communicable disease care in disaster.** ***Prehosp Disaster Med*****. 2017;32(6):657-661.**

## Introduction

Sudden onset disasters (SODs) are estimated to have affected more than 1.5 billion people over the 10-year time frame of 2005-2014.[1] Nations that do not have the ability and capacity to cope with the effects of SODs are more vulnerable to the negative impacts of SODs.[2] Moreover, the world's most disaster-prone nations are low- to middle-income nations that are most vulnerable, often with stark disparities in health system access between rich and poor, urban and rural populations.[2] At the same time, there is an epidemic of non-communicable diseases (NCDs) emerging in low-income nations as they progress in their economic development and chronic diseases become more common.[3] Seventy-four percent of deaths across the globe from chronic diseases such as diabetes, heart disease, hypertension, and chronic respiratory illness are in low- and middle-income countries.[3]

Large-scale SODs, such as the Haiti earthquake (2010) and Typhoon Haiyan (2013), have resulted in the deployment of emergency medical teams (EMTs; previously known as foreign medical teams [FMTs]) specifically to assist disaster-affected populations.[4,5] The largest and best-equipped EMTs aim to provide emergency surgical trauma care in the first few days following a disaster.[6] The emergence of a NCD epidemic in the world's most disaster-prone nations raises specific challenges for the preparedness of surgically-focused EMTs called upon to respond to SODs. The combination of diabetes and disaster is a useful model to consider the way in which NCDs impact acute surgical care of disaster-affected patients. At a population level, disaster leads to a deterioration in diabetic control and worsens risk factors such as hypertension and cholesterol many months after the event.[7] In the post-disaster period, surgical teams should expect to manage a significant cohort of diabetic patients in the post-operative period.[8]

The publication of the World Health Organization's (WHO; Geneva, Switzerland) standards and classification guidelines for FMTs (henceforth known as EMTs) provides a useful framework for the minimum standards required for an EMT delivering care in a SOD.[9] However, the guidelines only briefly address standards for the treatment of NCDs.

Furthermore, there is limited literature describing the lessons learned by deployed EMTs and the challenges they have faced in treating NCDs in situations of acute health system collapse.

There are specific human resource, laboratory, and pharmaceutical requirements to treat NCDs that are not addressed in current guidelines for deployed surgical field facilities.[9,10] Equally important is the provision of adequate medical records to the patient and their re-integration into the recovering health system.[11] In this report, the authors use their experience treating diabetic surgical patients during the 2013 Typhoon Haiyan disaster as a case study of NCD management in a surgical field hospital and describe the insights gained alongside a framework for future responses to improve the care of diabetic patients in the field.

## Report

Typhoon Haiyan (known locally as Yolanda) that made first landfall over Eastern Samar Province in the Philippines on November 8, 2013 represents one of many large-scale, natural SODs to affect the nation in recent times.[12] The damage caused by this category five typhoon was catastrophic - 16 million people were affected, official number of fatalities stands at 7,354, and 28,626 injuries were attributed to the typhoon.[12] The Australian Government, in part of a $40 million response package, deployed an Australian Medical Assistance Team (AusMAT) with a surgical field hospital (EMT Type 2) to the major center of Tacloban City (population 220,000)[13] on day six post-disaster for a period of 23 days,[14] from November 16, 2013 to December 7, 2013.

Two consecutive teams deployed with the majority of medical and nursing staff from an emergency medicine, surgical, or anesthetic background. A specialist pharmacist accompanied each team. The absolute numbers of medical and nursing staff complied with WHO EMT published standards. Given the team was selected as an acute trauma surgery team, only a single internal medicine physician deployed with each team, and no nursing staff with a primary specialty of inpatient ward nursing was deployed. Laboratory capacity was limited, and for the purposes of managing diabetic patients, only blood glucose monitoring and dipstick urinalysis were available. The deployed pharmacy contained 600 units of fast-acting insulin (aspart), 500 doses of metformin, and no sulphonylureas.

The capacity of the facility was 40 inpatient beds and one main operating table with one extra table on-call 24 hours for emergent cases. During the deployment, there were 222 operating theatre (OT) visits in 131 patients. Seventy-three of the 222 (32.9%) OT visits and 30 of the 131 patients (22.9%) were diabetic. Diagnosis of diabetes was confirmed either through history or acute blood sugar level measurement >11.1 mmol/L.

The majority (26 of 30; 86.7%) of the diabetic cohort presented with a typhoon-related injury, with the remaining four patients sustaining trauma during the recovery phase. The characteristic diabetic patient presented a few days after a relatively minor soft tissue injury, usually of the lower limb, often from stepping upon or being struck by debris. Diabetic patients required more operations than their non-diabetic counterparts (average 2.4 versus 1.5). All five major amputations (trans-tibial or trans-femoral) were performed in diabetics, as a consequence of advanced sepsis rather than mangled extremity (Table 1). A likely combination of lack of wound care, lack of access to medicines, and poor control of underlying diabetes had presumably led to the advanced soft tissue infection.

| | Diabetes | No Diabetes |
|---|---|---|
| Surgical Patients | 30 | 72 |
| Typhoon-Related Injury | 26 | 48 |
| Non-Typhoon-Related Injury/Illness | 2 | 23 |
| Major Amputations | 5 | 0 |
| Minor Amputations[a] | 11 | 2 |
| Operating Theatre Visits per Patient, n (mean) | 73 (2.4) | 107 (1.5) |



**Table 1**. Characteristics of Adult[b] Operative Procedures in the AusMAT Field Hospital

Abbreviation: AusMAT, Australian Medical Assistance Team.

[a] Minor amputation defined as trans metaphylanges and distal, major proximal.

[b] Equal to or aged greater than 15 years of age.

Patients were referred from the primary care/emergency section to the surgeons who reviewed the patient and determined the need for operation. Surgical management was by drainage and excisional debridement second daily until tissue appeared healthy and infection was controlled. Although the internal standard for wound management was for eventual wound closure with direct suture, random pattern flap, or split skin graft, during this deployment, healing by secondary intention was the preferred management as the surgical team considered closure a risky strategy where comprehensive post-discharge follow-up could not be guaranteed. In keeping with guidelines for austere environments, wounds were irrigated with potable water and dressed with simple gauze.[15] Antimicrobial therapy was a third-generation cephalosporin and metronidazole, with meropenem available for refractory cases. Response to treatment was assessed clinically. Inpatient glycemic control was achieved with short-acting insulin, and patients were recommenced on oral hypoglycemics if it could be demonstrated that they had previously been prescribed pre-disaster. Instituting new diabetic therapy with oral hypoglycemics was not possible from a perspective of medication supply and not considered safe given the difficulty with follow-up. Therefore, strict glycemic control was not achieved in this cohort. Given the initial absence of local health services, patients remained in hospital or were discharged home and returned for outpatient follow-up using the hospital's integrated patient transport. At the end of deployment, patients with ongoing wound or other medical issues were referred to a local regional medical center. Current inpatients in the field hospital at this time were directly transferred to other hospitals at the direction of the local Ministry of Health.

## Discussion

The latest world disaster risk index shows that eight of the top 15 most disaster-prone nations are in the Asia-Pacific, with the Philippines having the second highest risk in the world.[2] At this time, Asia is the site of a rapidly emerging diabetes epidemic, with Indonesia, the Philippines, and Bangladesh among the top 10 nations globally with the highest increases in diabetic prevalence.[16] The reported prevalence of diabetes in the Philippines is 6.1%.[17] During the AusMAT experience in the Typhoon Haiyan



https://doi.org/10.1017/S1049023X17006707 Published online by Cambridge University Press

deployment, the proportion of surgical patients with diabetes was four times higher than the baseline prevalence of the disease. Previous studies have shown high proportion of acute presentations due to chronic disease after SOD;[18] however, there have been very few descriptions of the burden of diabetes amongst patients treated by deployed field hospitals.[8]

The traditional priority areas after disaster have been injury management and resumption of public health services, focusing on surveillance and management of communicable disease, including resumption of immunization programs.[19,20] Given the expanding NCD epidemic facing disaster-prone nations, there may be a strong argument for giving equal weight to the restoration of pre-disaster levels of care for NCDs as early as possible. This may require a shift in mindset to NCD management being a relief-phase priority.

The AusMAT experience during Typhoon Haiyan presented a number of challenges for the management of the diabetic surgical patients. Due to the extent of the structural damage, people were unable to return to their homes for a prolonged period of time. Hospitals and health clinics were not functioning. Local medical supplies depleted quickly, and within days, people with diabetes found that they had no medication and limited means of getting renewed supply. The medication available was limited and so normal regimes were not available, meaning that people had to change to unfamiliar drugs. Prescriptions were not necessarily available along with medical records and so reliance was made on diabetic patients memorizing their regular medication regimes. Using interpreters to obtain medical history compounded this uncertainty. These challenges mimicked those described by Cefalu et al in an analysis of the effects of Hurricane Katrina (2005; Gulf Coast, USA) on diabetic patients.[21] Such similarities raise the question about the types and quantity of medication required for disaster deployments.

Choosing medications to accompany the deployment is a particular challenge and highlights the limitations of international guidelines and recommendations for acute management of NCDs.[9] The AusMAT medication supply during the Haiyan response consisted of 600 units of fast-acting insulin and 500 doses of metformin (sufficient for 166 patient days of treatment at a standard starting dose). There is a considerably broader range of agents available in donor nations that deploy field hospitals. Clinical staff must be familiar with the initiation and use of older agents to which they may no longer be familiar. Following the Haiyan experience, the AusMAT pharmacy now holds short- and intermediate-acting insulin, metformin, and gliclazide.[22] Alignment with the national formulary of the disaster-affected host nation is essential in pre-departure preparation. It is also anticipated that patients will be provided with up to 14-day supply of medications on discharge.

The pathophysiology of diabetes leads to impaired immunity, predisposition to infection, and impaired wound healing. In this experience, relatively minor trauma led to presentations with complicated infections requiring surgical intervention. There is considerable evidence that the healing of infected wounds is assisted with optimal glycemic control.[23,24] Surgical field hospitals must have an effective inpatient diabetic management capability across a number of domains.

The AusMAT experience in the Philippines raises the question about the minimum human capital required to appropriately and ethically service populations in the setting of a SOD. Miller suggests the inclusion of diabetes specialists, such as a diabetic educator, in the team; however, the latest guidelines do not advise on sub-specialties.[9,25] Generally, all clinical staff have been trained in critical care; therefore, it could be suggested that they all are trained to manage NCD in the setting of disaster. However, it is not always clear whether this translates to comprehensive skills in chronic disease management.

As with all chronic diseases, optimal treatment of diabetes requires a collaborative, multi-disciplinary approach and a robust interface between inpatient and outpatient care services.[26] There is a disparity in expenditure for diabetes care world-wide. Of the world's diabetics, 75% live in low- and middle-income nations, where only 19% of the expenditure occurs. This disparity suggests that highly developed models of chronic disease care are beyond the reach of the world's most disaster-prone nations. Even in the developed world, SOD has been shown to negatively affect glycated hemoglobin measurements up to 16 months post-disaster.[7]

An even more pertinent management issue in NCDs is the pre-disaster level of diagnosis, treatment, and services in the affected community. Teams should expect patients who are undiagnosed diabetics, or if they are known diabetics, have not been initiated on treatment due to lack of access. Higuchi found that many diabetic patients in the Philippines took intermittent medication based on their own judgment, and/or only selected certain pieces of medical advice because they weighed symptoms against the household budget.[27] In this scenario, the clinical decision on treatment initiation is even more complex and needs to take into account the acute clinical need for glycemic control against the action of commencing a medication regime which the patient cannot access into the future. The team leaders of deployed field hospitals must rapidly and accurately assess the accessibility of services for patients, and take steps to integrate any management plans with either the Ministry of Health or other providers, in order to inform inpatient clinical decision making.

The ability of patients to access community follow-up care is a likely challenge. Patients in this cohort required, on average, 2.4 debridements of their wounds in the OT. Surgical hospitals must have sufficient inpatient capacity to admit diabetic patients for recurrent visits to the OT, and patients need to have acute post-discharge wound care. Deployed teams should consider all possible solutions to facilitate this, including: provision of outpatient follow-up services, including patient transport for the operational period; engagement with the Ministry of Health and other agencies through health cluster meetings; and advocacy for the prioritization of medicine access and restoration of primary care services.

The decision to prioritize NCD management after a disaster is unlikely to be given equal weight without robust data demonstrating improvement in outcomes. The responsibility for comprehensive data collection and handover to local authorities rests firmly with the deployed teams.[9] The AusMAT Haiyan experience highlighted significant limitations in the capacity for data collection and analysis for NCDs, compromising the ability to assess the effects of the interventions on even short-term outcomes. While the authors acknowledged the challenges of data collection in disaster, for future deployments, a more comprehensive data collection strategy, outlined in Table 2, is planned. This includes a blood sugar level recorded for every patient and comprehensive clinical handover and discharge summaries for the patient to keep and for the local health service. This is essential for ongoing medical care. Future studies are planned to validate this strategy and opportunities exist to partner with disaster-affected nations to trial data collection tools.[28]

| Team Composition and Equipment | Leadership and Engagement | Patient-Centered Care | Data and Medical Records |
|---|---|---|---|
| Field hospital medication inventories should be enhanced to include a range of common drugs for chronic disease. | Early contact should be made with local health services to understand pre-disaster access to primary care services to inform clinical management decisions in the hospital. | Teams must be able to provide basic education in chronic disease management in a language and context understood by the patient. | Data collection systems must be able to record details on the management of chronic diseases and the outcomes for patients. |
| Field hospital staff should include internal medicine specialists and nurses familiar with inpatient management of chronic disease. | Where primary care services have not been re-established by the local Ministry of Health, the deployed field hospital should partner with another agency to handover care of patients with chronic disease. | Every effort should be made to sustain the health outcomes achieved during the admission by linking the patient with local or partner non-governmental organization primary care services. | Field hospital medical records should accompany the patient as they re-integrate into the local health system. |
| Consideration should be given to prescribing medication on discharge from the facility and inventories supplemented accordingly. | Team leaders should advocate at Ministry and Health Cluster level for the urgent resumption of services to manage non-communicable disease. | Surgical teams offer follow-up care in the immediate post-disaster period when primary care services are being established. | Surgical interventions and inpatient management are clearly documented in a format accessible to local health practitioners. |
| Field hospitals should have clear guidelines on chronic disease management. | Management of non-communicable disease should rank alongside infectious disease surveillance and resumption of immunization as key priorities in the early recovery phase. | | |



**Table 2**. Model for Acute Non-Communicable Disease Care Post Sudden Onset Disaster

## Conclusion

The AusMAT experience during Typhoon Haiyan presented a number of challenges for the management of the diabetic surgical patients. The authors suggest that instituting preparedness measures, clear operational guidelines on field management and patient follow-up, strong integration with Ministry of Health services in the relief and recovery phase, and improved medical record keeping and discharge summaries for the patient as the pillars for improving acute clinical care of this patient cohort. These general principles can be applied across the expanding range of NCDs that deployed field hospitals are likely to encounter.


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https://doi.org/10.1017/S1049023X17006707 Published online by Cambridge University Press