Doctoral Thesis

International Doctoral Program in Global Health, Humanitarian Aid and Disaster Medicine

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Operational resources in humanitarian setting: the Mozambique case after the Cyclone Idai, disaster and recovery phases

By

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Declaration

I hereby declare that, the contents and organization of this thesis constitute my own original work and does not compromise in any way the rights of third parties, including those relating to the security of personal data.

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April, 2022

* Thesis submitted in fulfillment of the requirements for the degree of Doctor of Global Health, Humanitarian Aid and Disaster Medicine.

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[1] Daniela Sacchetto, Mario Raviolo, Silvia Lovesio, Flavio Salio, Ives Hubloue, and Luca Ragazzoni. Italian field hospital experience in Mozambique: report of ordinary activities in an extraordinary context. *Prehospital and Disaster Medicine*, 37(4):553–557, August 2022. doi: 10.1017/S1049023X22000772.

[2] Daniela Sacchetto, Mario Raviolo, Ives Hubloue, Martina Valente, and Luca Ragazzoni. Team dynamics and non-technical skills perception during a disaster response (Mozambique 2019): a survey study among the Italian Emergency Medical Team (EMT). *Disaster Medicine and Public Health Preparedness*. Submitted on December 20, 2022.

[3] Andrea Conti, Daniela Sacchetto, Giovanni Putoto, Marcello Mazzotta, Giovanna De Menenghi, Emanuela De Vivo, Lorenzo Lora Ronco, Ives Hubloue, Francesco Della Corte, Francesco Barone-Adesi, Luca Ragazzoni, and Marta Caviglia. Assessment of the South African Triage Scale (SATS) in a new ambulance system in Beira, Mozambique. *International Journal of Environmental Research and Public Health*, 19(16):1–12, August 2022. doi: 10.3390/ijerph191610298.

[4] Daniela Sacchetto, Mario Raviolo, Cristiano Beltrando, and Nicola Tommasoni. COVID-19 surge capacity solutions: Our experience of converting a concert hall into a temporary hospital for mild and moderate COVID-19 patients. *Disaster Medicine and Public Health Preparedness*, pages 1–4, October 2020. doi: 10.1017/dmp.2020.41.

Acronyms

ASLTO	Azienda Sanitaria Locale Città di Torino
BeTS	Beira Triage System
BRT-13	Short-form Benchmark Resilience Tool
CHB	Central Hospital of Beira
COVID-19	Coronavirus Disease 2019
CPAP	Continuous Positive Airway Pressure
CRIMEDIM	Center for Research and Training in Disaster Medicine, Humanitarian Aid, and Global Health
EMS	Emergency Medical Service
EMSRS	Emergency Medical Services Resilience Scale
EMT	Emergency Medical Team
EMT2-ITA	Emergency Medical Team Type 2 – Italy Regione Piemonte
ER	Emergency Room
ERS	Emergency Referral Services
EUCPM	European Union Civil Protection Mechanism
HC	Health Centre
ICU	Intensive Care Unit
ID	Unique Identifier

IPC	Infectious Prevention and Control
LAN	Local Area Network
LMIC	Low- and Middle-Income Country
MH	"Molinette" Hospital
MNA	Mozambique National Authorities
ModEx	European Modular Exercise
MOH	Ministry of Health
MSF	Doctors Without Borders/Médecins Sans Frontières
NGO	Non-Governmental Organization
OGR	Officine Grandi Riparazioni
OT	Operating Theatre
PI	Principal Investigator
POS	Perceived Organizational Support scale
PPE	Personal Protective Equipment
PSA	Pressure Swing Adsorption
PTSD	Post Traumatic Stress Disorder
SATS	South African Triage Scale
SE	Self-Efficacy Index
TEWS	Triage Early Warning Score
TW	Teamwork Index
TW_{12}	Overall team's performance Index
UN	United Nations
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization

Chapter 1

Introduction

1.1 Background and motivation

Natural disasters cause, approximately, the death of 60,000 people per year [1]. According to the international disasters database, EM-DAT [2], 420 natural disasters occurred in 2021 worldwide, killing 13,849 people and affecting about 73 million people. The estimated amount of economic damage came to almost US$ 218 billion.

All countries are vulnerable to natural disasters: even if the low- and middle-income countries (LMIC) appear to be more affected by disaster with consequences amplified by the weakness of the local health systems, recent instances of highly infectious diseases such as Ebola, SARS and, more than any other, COVID-19 pandemic, with its huge impact on high-income countries too, shows that no country is immune to disasters.
Depending on the magnitude and impact of the disaster, the international humanitarian response can be activated. Different types of disasters require different types of response, depending on deaths, injuries, damage of health facilities, water and food shortages and major population movements. Figure 1.1 lists the magnitude of effects that natural disasters have on these outcomes.

The Haiti earthquake in 2010 involved many Emergency Medical Teams (EMT) differing widely in terms of capacity, health objectives, and scale, ranging from the well-prepared to the poorly trained and ill-equipped ones. Moving from that experience, the World Health Organization (WHO) created a global classification system and minimum standards for EMTs responding to disasters, that is globally known as the "EMT Initiative". The purpose of the EMT Initiative is to improve the quality of health services provided by EMTs and to enhance

Effect	Earthquakes	Tropical storms	Tsunamis	Slow-onset floods	Landlines	Volcanoes/ Lahars
Deaths	+++	+	+++	+	+++	+++
Severe injuries	+++	++	+	+	+	+
Risk of communicable diseases	Potential risk following all major disasters (Probably rising with overcrowding and deteriorating sanitation)					
Damage to health facitlites	+++ Structure/ equipment	+++	+++ Localized	+++ Equipment only	+++ Localized	+++ Structure/ equipment
Damage to water systems	+++	+	+++	+	+++ Localized	+++
Food shortage	Rare (Economic and logistic factors)		Common		Rare	
Major population movement	Rare (Heavily damaged urban areas)		Common (Generally limited)			

Figure 1.1 Magnitude of effects from natural disasters [3].

the capacity of national local authorities in the activation and coordination of this response in the immediate aftermath of a disaster.
The classification of EMTs depends on capability, capacity and level of healthcare assured. In particular:

- EMT Type 1 or "Outpatient Emergency Care" (fixed or mobile, with or without facility)
- EMT Type 2 or "Inpatient Surgical Emergency Care"
- EMT Type 3 or "Inpatient Referral Care"
- Specialized Care Teams such as rehabilitation, burn injuries, disease management, etc

Figure 1.2 summarizes the EMTs classification and minimum standards required.

Except for EMT Type 1 mobile, all the EMTs are able to deploy a field hospital, entirely self-sufficient regarding logistics, medical aspects and staff: the complexity and level of healthcare services offered by the field hospital depend on the EMT Type.
For most disasters, the first wave of trauma patients needing assistance in the hours/days immediately after the disaster, is followed by non-trauma/medical cases presenting themselves at the local hospital or the EMTs for routine care. In particular, after the disaster, the local hospitals may not be fully operational and, after the first wave, may be overwhelmed by the need for secondary care for the trauma victims as well as for normal emergencies and routine medical care.
The main role of the EMTs deploying a field hospital, after an official invitation from the host

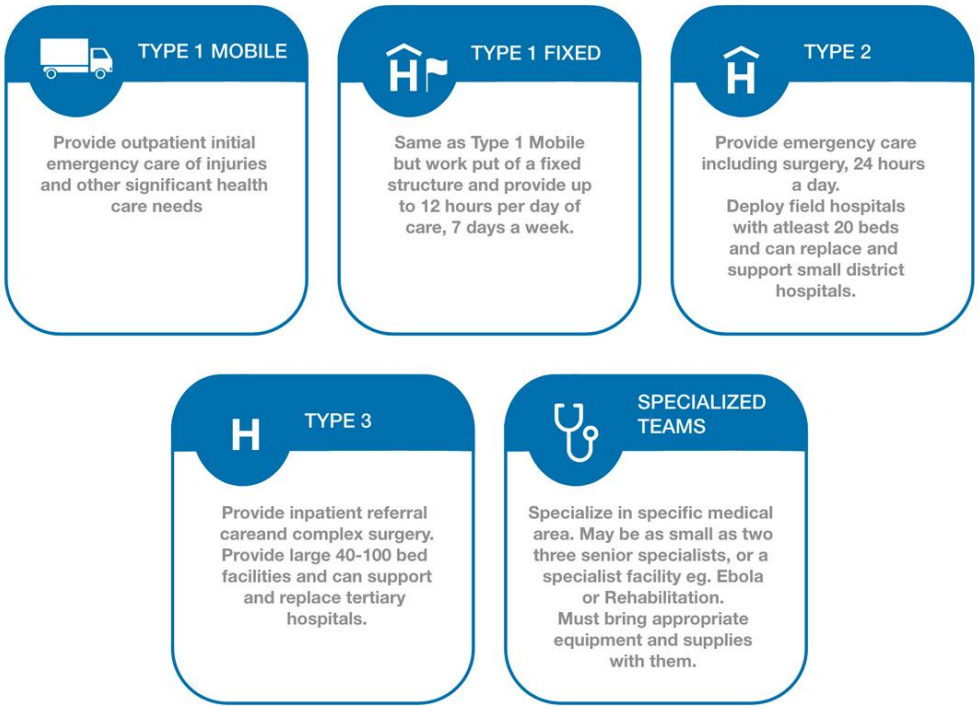

Figure 1.2 EMTs classification diagram [4].

country, is to temporarily fill the gaps in medical assistance resulting either from the large number of casualties or the inability of the local facilities to cope with the normal medical activities.
Donating the field hospital to the host country at the end of the mission (standard duration from 2 to 8 weeks depending on EMT type and availability of rotation) is a quite common practice. Also if the use of donated field hospitals may appear as the ideal no-cost and ready-to-use alternative to the local damaged health facilities during their reconstruction or repair, it involves important issues for both the donor and recipient (training, maintenance, utilities).

Each disaster raises many questions about how best to respond, but evidence is often lacking or incomplete to answer such questions. Innovative research on global health, humanitarian aid and disaster medicine is therefore essential to improve the knowledge and the interest for those responding to disasters, to provide the scientific evidence for disaster relief and to enhance the preparedness for future events. Conducting research during or in the aftermath of disasters is also crucial to accurately describe and report phenomena, response type, experiences and lessons learnt. Moreover, disaster research can support and guide decision-makers.
A number of major challenges exist for disaster research, starting from the highly adverse environmental conditions and stressful context, the difficulties to collect data, the need to not hinder the operational response, the attention to the ethical issues common to all research

involving human subjects [5, 6], but its contribute can change the outcomes for the affected populations and the healthcare providers.
Being part of a relief team, the Emergency Medical Team Type 2 – Italy Regione Piemonte (EMT2-ITA), I directly took part in the humanitarian mission conducted after the Cyclone Idai that hit the Mozambique in 2019. This experience turned out to be a "shortcut" to implementing scientific research, giving me the opportunity to carry out some important research projects during both the disaster and the recovery phases, with interesting results and exciting points of discussion. Moreover, my research work included two operational works, that directly involved me during the Coronavirus Disease 2019 (COVID-19) pandemic: being the engineer of EMT2-ITA, I was in charge for the planning and the coordination of the deployment of two temporary hospitals for mild and moderate patients in the city of Turin, during the first and the second Italian waves of the pandemic (March-April and November 2020). COVID-19 has been a huge, widespread disaster involving and surprising everyone all over the world: the relief response has often been improvised to cope the surge of patients and the overwhelm of local health facilities. It was urgent to do research also on this field to be more prepared for future events.

My research activity tried to answer the following open questions:

- What are the main activities of an EMT Type 2 during its first mission after the WHO classification? How can the timing influence the type of activities on the field? Is the integration with local staff possible?
- What about the team dynamics? Does an EMT truly perform as a team on the field?
- What about the resilience of personnel and organizations involved in an humanitarian mission?
- How can the host country respond to the emergency during the recovery phase after a disaster? Can the access to primary healthcare be improved with the introduction of a specific triage method?
- How can the EMT experience and standards be applied on COVID-19 "home" emergency?

1.2 Mozambique 2019

1.2.1 The disaster phase

On March 15th, 2019, Cyclone Idai made landfall near the port city of Beira, in the central region of Mozambique. The heavy winds and rains caused death, destruction and devastation in the city and in the villages all around it: 602 people died, 1,641 were injured, and 239,682 houses were damaged or destroyed [7]. After the activation of the European Union Civil Protection Mechanism (EUCPM), many rescue teams were sent to help the affected population: the EMT2-ITA set up a working field hospital in the courtyard of the Central Hospital of Beira (CHB), strongly damaged by the cyclone. Data collected from the patient chart review and from different surveys submitted to the rescue team, allowed me to carry out three important research studies.

First of all, the report of the operational and clinical activities of the EMT2-ITA regarding the type of patients and procedures, the mobilization and deploy timing and the staff working during the response, allowed to analyze the first mission after the WHO classification of an EMT type 2, focusing on main outcomes and challenges overcome.

Second, the teamwork and team dynamics in general, that are crucial for EMTs to work effectively together in the field, seem to be neglected by the disaster research. In fact, the Mozambique mission in 2019 was the first time in which a research project regarding these important aspects was conducted during a real mission: the study was based on the survey data collected from the EMT2-ITA personnel from a self-assessment perspective.

Finally, to better investigate the impact of disasters on the mental health of disaster relief teams, a second survey study was conducted between the EMT2-ITA deployed to Mozambique in 2019. In particular, the choice to explore the connection between resilience (organizational and personal) and perceived organizational support moved from the belief that, for humanitarian organization, it is really important to invest in this direction. Data regarding personnel directly involved in an humanitarian mission can help to reach this goal.

1.2.2 The recovery phase

Organized emergency referral services (ERS) are uncommon in LMICs and, when present, often suffers of structural inefficiencies, lack of resources and skilled staff. Triage should be considered a fundamental part of ERS especially in resource-constrained settings, where such protocols can provide a cost-effective tool to prioritize urgent cases and to optimize resource

usage. However, scientific literature on prehospital triage in LMICs settings is currently scarce. The South African Triage Scale (SATS)[8–10] is a triage protocol specifically developed for LMICs, and extensively validated within several emergency departments. However, its assessment in the prehospital setting has been performed only through indirect methodologies, such as clinical vignettes or focus group discussions.

During the recovery phase after the Cyclone Idai, from June to December 2019, the SATS was introduced in the referral system from peripheral health centres (HCs) to the CHB. This research project intended to improve the access to essential primary healthcare services, through interventions aimed at improving the skills of healthcare personnel in identifying danger signs among patients and in referring cases to the CHB appropriately. Thus, the integration of the SATS aspired to improve the referral process, prioritizing the most urgent cases and optimizing the ERS's usage. Observing the pattern of the severity of transported patients and the triage accuracy over the time, the study can move important considerations about the SATS introduction in the prehospital setting of a LMIC.

1.3 Organization of the thesis

This thesis is organized as follow.

In Chapter 2 the response of the EMT2-ITA in the aftermath of the Cyclone Idai in Mozambique is reported. The EMT2-ITA was deployed about two weeks after the disaster to support the country in need providing essential medical and surgical care. The EMT2-ITA staff was composed by 77 team members including two rotations and integrating local staff. A total of 1,121 patients (1,183 triage admissions) were treated during the 27 days of field hospital activity; among all the admissions, only few cases (17; 1%) were directly or indirectly attributed to the disaster event. Only three cases of cholera were confirmed and transferred to one of the treatment centers set up in the city of Beira. The EMT2-ITA performed a total of 62 surgical operations (orthopedic, gynecological, general and plastic surgery) of which more than half were elective procedures. The objective of this chapter is to report the mission of the EMT2-ITA in Mozambique, raising interesting points of discussion regarding the impact of timing on the mission outcomes, the operational and clinical activities in the field hospital and the great importance to integrate local staff into the team.

In Chapter 3 two research studies regarding the disaster phase, conducted among the personnel of the EMT2-ITA, are presented.
The *Team dynamics Study*, reported in Section 3.1, is focused on teamwork and non-technical

skills: to the best of my knowledge, no study has ever examined these important issues during a real mission in the field. Therefore, little is known whether an Emergency Medical Team (EMT) is able to perform as a team without a prior specific training that enhances the teamwork. The *Team dynamics Study* aims to better investigate team dynamics and non-technical skills for EMTs, trying to understand if a real mission (the response of EMT2-ITA in Mozambique, 2019), when the people are obliged to work together for the first time, without a prior specific training focused on teamwork, is enough or not to work as an effective team in the field. The study, designed as pre-test/post-test survey study, collected data from 51 people deployed to Mozambique in 2019. Three indexes, the Self-Efficacy (SE), the Teamwork (TW) and the overall team's performance (TW_{12}), were calculated as the average value of the rating given by all the participants. Open text feedback were collected too. A positive trend was observed comparing the "post" data to the "pre" data, but the results do not show a statistically significance, except for the stratified analysis showing a p-value less than 0.05 for SE and TW_{12} for some categories. According to the study findings, humanitarian workers, obliged to work together for the first time without a prior specific training, feel good but not at their best: training programs focused on team working dynamics can be really useful to improve self-confidence of people leaving for a mission.
The *Resilience Study*, reported in Section 3.2, collected data regarding the resilience, evaluated at two levels, personal and organizational, and the perception of the support that organizations give to their employees, between the disaster-response personnel of EMT2-ITA in Mozambique in 2019. In particular, the study aims to investigate the association between the resilience and the perceived organizational support, going deeper to the different dimensions of the resilience itself. The EMT2-ITA staff deployed to Mozambique was asked to answer an online survey between November and December 2019: forty-three of the them (response rate: 56%) completed the whole survey. Three validated tool were assessed: the Perceived Organizational Support scale (POS) recorded as average score of 1.99 ± 0.56 (95% CI: 1.82, 2.16), the short Benchmark Resilience Tool (BRT-13) of 1.76 ± 0.45 (95% CI: 1.62, 1.90) and the Emergency Medical Services Resilience Scale (EMSRS) of 2.32 ± 0.30 (95% CI: 2.23, 2.41). A strong Pearson correlation was found between POS and BRT-13, while no association emerged between POS and EMSRS, except for the factor of job motivation. Therefore, the study showed a good resilience, both organizational and personal, and a good perceived organizational support for the team deployed in Mozambique in 2019. Above all, the study revealed a strong association between the organizational resilience and the perceived organizational support, that can be a useful information for managers to start or continue to invest in this direction.

Chapter 4 moves to the recovery phase after the Cyclone Idai in Mozambique.
In particular the *Beira Triage System (BeTS) Study* is presented. In 2019 the city of Beira

(Mozambique) implemented an urban ambulance system to refer patients from HCs to the CHB. While the system initially did not contemplate a referral protocol, thus leading to unregulated referrals to the CHB and overstretching its resources, the SATS has been subsequently introduced in three selected HCs to govern the patient transfer service. The *BeTS Study* was conducted from October 2019 to June 2020, collecting 2,636 patient referral charts and aimed to assess the effect of SATS implementation on the prehospital selection process and the accuracy of triage performed by the nurses. After SATS implementation, the proportion of referred orange and red codes significantly increased (+12.2%; +12.9%) while the proportion of green and yellow codes decreased (-18.7%; -5.8%). The overall rate of triage accuracy, under and over-triage were 34.2%, 36.3% and 29.5%, respectively. Logistic regression analysis showed a positive association between time and accuracy of triage (p value < 0.05). In conclusion, the use of the SATS improved the prehospital selection process, modifying the pattern of referred patients and increasing the number of severe cases receiving advanced medical care at CHB. While triage accuracy improved with the routinary application of the protocol, the observed rates of mis-triage suggest that further analysis are needed to examine factors that affect SATS accuracy in the prehospital setting.

Then, in Chapter 5, two operational works, regarding the COVID-19 pandemic, are collected. Firstly, as described in Section 5.1, a temporary hospital was developed during the first COVID-19 wave, that severy hit northern Italy in early Spring 2020. At the end of March 2020, the Piemonte (Northern Italy) Government decided to build a temporary rapid-assembly emergency hospital for the treatment of mild and moderate COVID-19 patients, converting an existing concert hall in the city of Turin. The decision was prompted not only by the urgent need of hospital beds, but also by a forward-looking approach for the months immediately after the emergency, when it will be essential for conventional hospitals to return to a normal configuration.
Secondly, as described in Section 5.2, at the beginning of Italian´s COVID-19 second wave in November 2020, an urban field hospital was set up in a public parking in the center of Turin. The main goal of this project wat to unburden the hospital system by providing care for an interim period to COVID-19 patients with a low level of medical complexity, who are not ready for or able to be discharged home.
These two sections document the projects, describing the sites, the layouts and the equipment, the idea behind structural choices and the staff involved. The aim of this chapter is to share the experience and to provide some practical recommendations to other professionals who are fighting the COVID-19 pandemic worldwide.

Lastly, in Chapter 6, general conclusions and future perspectives are reported.

Chapter 2

Disaster phase - The Italian field hospital response

This chapter is based on:

Daniela Sacchetto, Mario Raviolo, Silvia Lovesio, Flavio Salio, Ives Hubloue and Luca Ragazzoni. Italian field hospital experience in Mozambique: report of ordinary activities in an extraordinary context. *Prehospital and Disaster Medicine*, 37(4):553–557, August 2022. doi:10.1017/S1049023X22000772.

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2.1 Introduction

In the early hours of March 15th, 2019, Cyclone Idai made landfall near the port city of Beira, home to 500,000 people, capital of Sofala Province, in the central region of Mozambique. Approximately 90% of the city of Beira was destroyed [7]. The cyclone, described by the United Nations (UN) as one of the deadliest storms on record in the Southern Hemisphere [11], caused a total death toll of more than 1,000 people (602 deaths in Mozambique, 344 people in Zimbabwe, and 59 people in Malawi) [12] and left 2,6 million people in need of humanitarian assistance [13]. Moreover, on March 27th, the Ministry of Health (MoH) declared a cholera

outbreak and through May, the number of cumulative cases increased to 6,766 with eight deaths [12, 14].
Under these circumstances, the EMT2-ITA was deployed approximately two weeks after the cyclone made landfall in Beira to support the country in need providing essential medical and surgical care. The EMT2-ITA is a classified World Health Organization (WHO) emergency medical team (EMT) Type 2, which is an "inpatient surgical emergency care" unit [15] able to assure 24-hour operativity, to provide 7 major/15 minor surgical operations per day, to manage 100 outpatients and 20 inpatients per day, and to remain totally self-sufficient from a logistical point of view.
The objective of this chapter is to report the first mission of the EMT2-ITA after the WHO classification, focusing on the operational and clinical activities in the field.

2.2 Sources

Data regarding the field hospital clinical activities were collected by the field hospital paper patient records and surgical procedures logbook filled by EMT2-ITA personnel during the entire mission. The purpose of this chart review was to depict a detailed picture of the clinical activity of the field hospital: the anonymous data of the patient records were manually entered into a data collection form (Microsoft Excel spreadsheet) following specific coding rules to detect the variables of interest. The data collector was a medical doctor in order to recognize medical jargon and to reduce the risk of misinterpretation of chart entries or notes. The resulting electronic database was reviewed by two other professionals with experience in chart review studies. In case of missing data, these were clearly stated with "not available" (N/A) value. The database was analyzed with Stata 15.1 (StataCorp LLC, Texas, USA).
The study protocol was submitted to the Ethics Committee at Ospedale Maggiore della Carità in Novara, Italy and obtained its review approval (protocol number 258/CE).

2.3 Observations

On March 20th, 2019, the European Union Civil Protection Mechanism (EUCPM) was activated following an official request for assistance of the Mozambique National Authorities (MNA) [16]. The day after, on March 21st, the EUCPM sent a request to the Italian Civil Protection Department. According to the needs and the resources available within the European voluntary pool, the EMT2-ITA was dispatched to Mozambique.

On March 30th, at 03.00 pm local time, the EMT2-ITA was the first EMT type 2 to become operational among the 13 different international EMTs that arrived in the country. Figure 2.1 shows the timeline of the mobilization phase of the EMT2-ITA from Italy to Mozambique. As requested by the MNA, the EMT2-ITA was set up within the courtyard of the CHB, which is one of the three tertiary-care referral hospitals of the country, serving more than 8 million people from Sofala province and from the central region of Mozambique [17]. Since the seven operating theatres (OTs) of the CHB were damaged and not functional from the day of the cyclone [18], the objectives of the EMT2-ITA were:

1. to support the CHB in its role as referral hospital for surgical care within its area of reference and
2. to become the receiving facility within the referral system established for the other international EMTs deployed in the region.

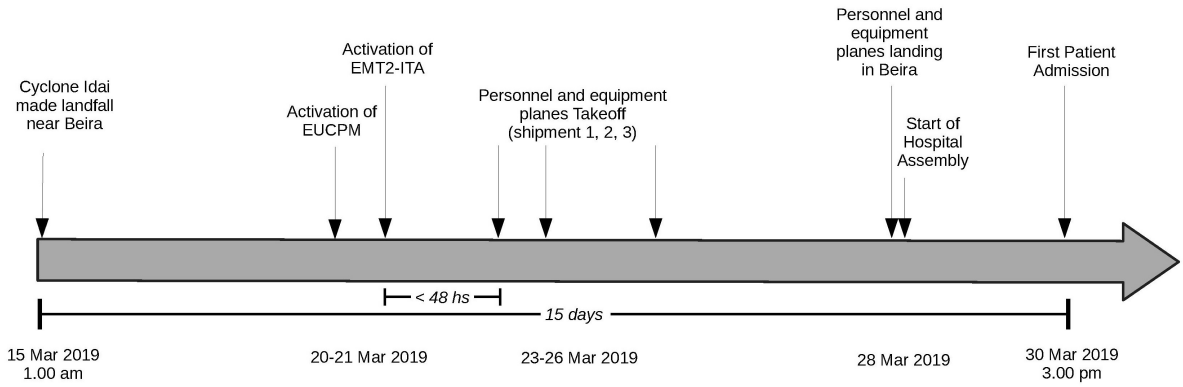

Figure 2.1 Timeline from cyclone to operational deployment.

The EMT2-ITA consisted of:

- A total of 77 team members including a first group of 56 people and a subsequent rotation of 24 people; three people ensured the continuity of the operations extending their stay for the whole deployment period (27 days). The second group was integrated by local staff, including medical doctors, surgeons and nurses for the clinical activities and technicians for the logistics ones. In details, the EMT2-ITA was composed of 58 healthcare professionals (29 medical doctors, including 2 team leaders and 1 deputy team leader, 27 nurses, 1 X-ray technician, and 1 midwife) and 19 operation support

personnel (1 engineer, 4 electricians, 2 water, sanitation and hygiene [WASH] experts, and 12 logisticians). Table 2.1 shows the structure of the staff working each shift in the different departments of the field hospital.

- A temporary structure of 9 tents with a total of 26 beds. As depicts in Figure 2.2, the functions of the 9 tents were:

  1. triage and registration,
  2. emergency room (ER),
  3. shock and critical care room (4 beds) with a gynecological corner,
  4. post anesthesia care unit and sterilization room,
  5. OT,
  6. isolation room for suspected or confirmed infectious disease (2 beds),
  7. x-ray and laboratory,
  8. n. 2 inpatient wards (10 beds for each tent).

During the 27 days of EMT2-ITA activity in Beira, 1,121 patients were treated. Given the several re-presentations, a total of 1,183 triage admissions were recorded.
The ages of the patients were highly variable (mean = 36.64, standard deviation = 18.80), ranging from newborn to 93 years. The 53% (596) of patients were females, within the adult age group (18-64). Among all the admissions, only few cases (17; 1%) were directly or indirectly attributed to the disaster event and they presented to the facility during the first 10 days of activity. Three cases of cholera were confirmed and transferred to one of the three treatment centers set up in Beira by Doctors Without Borders/Médecins Sans Frontières (MSF). Almost all the admissions (1,071; 91%) ended with discharge the same day of admission and more than half of them (705; 60%) were due to chronic conditions. Table 2.2 summarizes the demographic and clinical characteristics of the patients presented to the EMT2-ITA in Mozambique.
As shown in Table 2.3, the EMT2-ITA performed a total of 62 surgical operations on 59 patients (three patients were operated twice). More than one-half were an elective procedure. Most of the surgeries were orthopedic (27; 44%), followed by gynecological (19; 31%), general (10; 16%), and plastic surgery (5; 8%).
The mission ended on April 25th, 2019 with the last three patients admitted during the night; all the field hospital equipment was handed-over to the CHB with a formal donation to the MNA.

Table 2.1 Structure of the staff working each shift (typically two shifts per day, eight hours) in the field hospital.

Field hospital department	**Personnel type per shift (n)**
Triage and registration	Nurse (1)
Emergency Room	Nurse (1) Emergency physician (1) Pediatrician* (1) Gynecologist* (1) Midwife* (1)
Shock and critical care room	Nurse (1) Anesthesiologist (1)
Post anesthesia care unit and sterilization room	Nurse (1)
Operating Theatre	Nurse (2) Surgeon (2) Anesthesiologist (1)
Isolation room	Infectious disease medical doctor*(1)
X-ray and laboratory	Nurse (1) X-ray technician* (1)
Inpatient Wards	Nurse (1)

*On call availability for some specialists (single figures in the team).

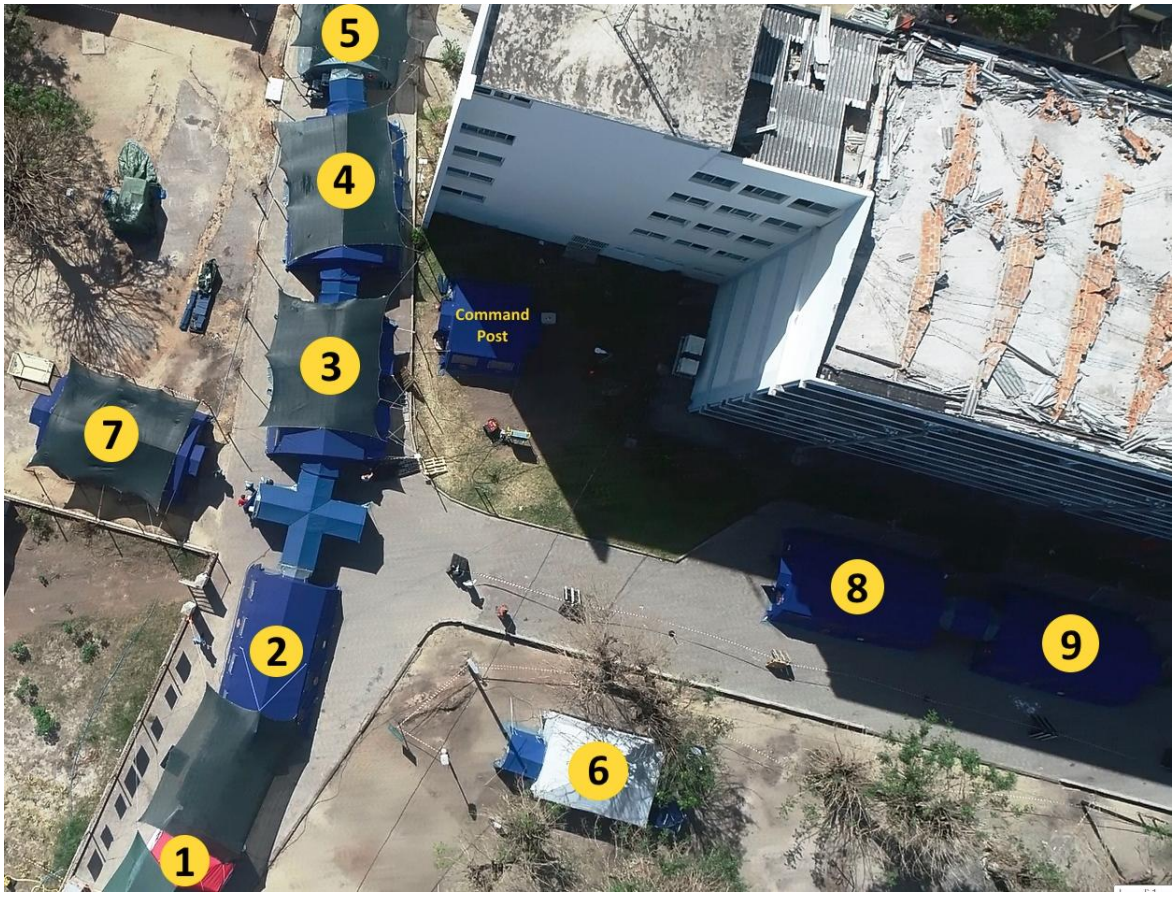

Figure 2.2 Deployed field hospital within the courtyard of the Central Hospital of Beira: (1) triage and registration, (2) emergency room (ER), (3) shock and critical care room with a gynecological corner, (4) post anesthesia care unit and sterilization room, (5) operating theatre (OT), (6) isolation room for suspected or confirmed infectious disease, (7) x-ray and laboratory, and (8)(9) inpatient wards.

Table 2.2 Summary of the demographic and clinical characteristics of the patients presented to the EMT2-ITA.

	Total n (%)
Age	
0 y	12 (1.0%)
1 - 4 y	73 (6.2%)
5 - 17 y	87 (7.3%)
18 - 64 y	931 (78.7%)
>65	79 (6.7%)
Unk	1 (0.1%)
Gender	
F	752 (63.6%)
M	431 (36.4%)
Triage category*	
G	1071 (90.5%)
Y	49 (4.1%)
R	7 (0.6%)
B	1 (0.1%)
NA	55 (4.7%)
Diagnostic category	
Gastrointestinal	178 (15.0%)
Muscoloskeletal	174 (14.7%)
Obstetric/Gynecology	160 (13.5%)
Miscellaneous	103 (8.7%)
Infectious	86 (7.3%)
Trauma	85 (7.2%)
Respiratory	84 (7.1%)
Surgical	75 (6.3%)
Genitourinary	62 (5.2%)
Neurological	62 (5.2%)
Cardiovascular	50 (4.2%)
ENT	40 (3.4%)
Dermatology	17 (1.4%)
Ophtalmology	5 (0.4%)
NA	2 (0.2%)
Outcome	
Discharged	1071 (90.5%)
Hospitalized	46 (3.9%)
Transferred	47 (4.0%)
Death	3 (0.2%)
Left	1 (0.1%)
NA	15 (1.3%)
Cyclone ralation	
Not related	1106 (93.5%)
Related	10 (0.8%)
Indirectly related	7 (0.6%)
NA	60 (5.1%)

*Color Codes according to this encoding: Green=Standard, Yellow=Urgent, Red=Immediate, Blue=Expectant.

Table 2.3 Summary of the 62 surgical operations performed by the EMT2-ITA.

	Total n (%)
Surgical Session	
Morning	26 (41.9%)
Afternoon	23 (37.1%)
Morning/Afternoon	3 (4.8%)
Afternoon/Night	3 (4.8%)
Night	3 (4.8%)
NA	4 (6.5%)
Equipe	
Italian	33 (53.2%)
Mixed	16 (25.8%)
Local	12 (19.4%)
NA	1 (1.6%)
Type of operation	
Elective	33 (53.2%)
Emergency	25 (40.3%)
NA	4 (6.5%)
Specialty	
Orthopedics	27 (43.6%)
Gynecology	19 (30.6%)
General Surgery	10 (16.1%)
Plastic Surgery	5 (8.1%)
Orthopedics + General Surgery	1 (1.6%)
Anesthesia	
Spinal	22 (35.5%)
General	9 (14.5%)
Spinal + Sedation	6 (9.7%)
Peripheral block + Sedation	5 (8.1%)
Peripheral block	4 (6.5%)
Sedation	4 (6.5%)
Spinal + Peripheral block	2 (3.2%)
NA	10 (16.1%)
Outcome	
Hospitalized	43 (69.4%)
Disharged	9 (14.5%)
NA	10 (16.1%)

2.4 Analysis

Describing the first mission of the EMT2-ITA after the WHO classification, this report raises interesting points of discussion regarding the impact of timing on the mission outcomes, the field hospital operativity, and the great importance to integrate local staff into the team.

First, the impact of mobilization timing on the clinical presentation: the EMT2-ITA became operational 15 days after the event due to the delayed request of assistance and the long travel

time. Only few patients with specific disaster-related injuries had access to the EMT2-ITA, in contrast to many patients coming to the field hospital for routine medical care. Similarly, the surgical activity was predominantly elective. As largely described in the literature, this clinical presentation is very typical in the aftermath of disasters. In 2005, Bar-Dayan and colleagues [19] reported only minimal effort in treatment of earthquake-related injured victims (90% of patients with non-traumatic illnesses) when describing the Israeli Defense Forces mission in Duzce, Turkey, after the earthquake of 1999. Bar-On, Peleg and Kreiss [3], in their recent book "Field Hospital: A Comprehensive Guide to Preparation and Operation", analyzed the evolution of health needs during a generic disaster, reporting the decrease of surgical in spite of medical cases in the first seven and 14 days after the event. In addition, the introduction of chronic disease care and rehabilitation in the WHO checklist of the minimum standards for EMTs type 2 [20], is further proof that EMTs must be ready to cope with daily emergencies and routine activities during their missions.
Additionally, the EMT2-ITA was embedded into the CHB, whose entire surgical floor was flooded, the roof damaged, the equipment destroyed, and the power supplies cut off after the cyclone. This meant that all the surgery rooms, except one for C-sections, were not functional. Therefore, apart from the timeline, it is clear the essential role played by the EMT2-ITA was replacing the surgery capacity and facing the routine patient load of the local hospital.
Even though the EMT2-ITA became operational just three days after the declaration of the cholera outbreak, only three cases presented to the field hospital and all of them arrived during the first week of activity. The epidemic curve of cholera cases reported by the WHO [21] shows a significant rise of cases in the first weeks after the cyclone, reaching the peak on April 8th, with a gradual decrease in the following days. From April 3rd to April 9th, the MoH conducted a mass-vaccination campaign that reached more than 800,000 people (90% of the target population) [12, 14, 21]. Moreover, the MNA and international partners, immediately set up several treatment centers and established a WASH taskforce, which then quickly implemented interventions to ensure the provision of safe WASH facilities for local population [22].

Secondly, the under-utilization of the inpatient wards: the small number of patients needing hospitalization after treatment were admitted directly inside the CHB (hospitalization rate = 4%). Admitting patients to the local hospital shows again the important complementary role of the EMT2-ITA for the CHB. According to this situation, it is evident the importance of the information provided during the request of assistance that, since it was done one week after the cyclone, should have reported data about the local hospital and the role expected for EMTs Type 2.
An equally important aspect regarding the field hospital management is that, although the

EMT2-ITA is ready to assure field hospital operativity 24/7, as requested by minimum standards established by WHO Classification, during the Mozambique mission, no patients presented at night, as transportation became much more difficult after dark. To adapt to this night in-activity, the personnel shifts were scheduled only during the day, while at night (from 12:00 PM to 8:00 AM) on-call availability was organized for the surgery room and a medical doctor supervised the ER and the triage tents, in case of patients coming.

Thirdly, the integration of the local staff in the team composition during the rotation of the personnel of the EMT2-ITA. This integration was really remarkable because, on one side, it allowed to limit the number of professionals coming from Italy and, on the other side, it ensured an effective training about the correct use and maintenance of the entire field hospital equipment before the final donation of it to the MNA.

2.5 Conclusions

In conclusion the data collected show once again that the main role of an EMT becoming operative several days after a disaster event, is the full commitment for elective activities, to support and maintain the ordinary healthcare capacity of the affected country: this is confirmed by the final report of WHO [23] regarding the Mozambique mission, reporting that the 82% of patients treated by EMTs were not related to the Cyclone Idai.
This is an important conclusion, driven by this and several other [15] direct experiences in the field, that must be kept in mind for different levels of the disaster response and management.

Chapter 3

Survey studies regarding the disaster phase

Part of this chapter is based on:

Daniela Sacchetto, Mario Raviolo, Ives Hubloue, Martina Valente and Luca Ragazzoni. Team dynamics and non-technical skills perception during a disaster response (Mozambique 2019): a survey study among the Italian Emergency Medical Team (EMT). *Disaster Medicine and Public Health Preparedness*. Submitted on December 20, 2022.

AUTHOR CONTRIBUTIONS: Conceptualization, D.S. and L.R.; methodology, D.S. and L.R.; validation, D.S.; formal analysis, D.S.; investigation, D.S.; resources, D.S.; data curation, D.S.; writing-original draft preparation, D.S. and L.R.; writing-review and editing, M.R., I.H. and M.V.; visualization, D.S.; supervision, L.R.; project administration, D.S.

3.1 The *Team dynamics Study*

3.1.1 Introduction

The EMTs "are teams of health professionals (doctors, nurses, physiotherapists, paramedics, etc.) that provide direct clinical care to people affected by emergencies and disasters, and support local health systems" [24]. They include governmental (both civilian and military) and non-governmental teams and, traditionally, they establish a field hospital made up of tents to provide life-saving medical and surgical care; the response to the Ebola outbreak or the recent

COVID-19 pandemic demonstrated also the great relevance they can have in other contexts, such as epidemics and complex emergencies [4, 25]. Team dynamics and non-technical skills in general are crucial for EMTs, as they must be able to coordinate their knowledge, effort and competencies in uncertain, time-pressured situations that characterize the disaster response.
Teamwork is the ability to work effectively together [26, 27] and is therefore essential to ensure safe and efficient patient care in ordinary and extraordinary contexts. The importance of teamwork is often emphasized within disaster and emergency medicine literature [27–31]: understanding the role of other professionals and learning how to work together are key aspects of successful disaster response [31].
In more general terms, non-technical skills, including teamwork, refer to a combination of cognitive and social competencies complementing knowledge and technical skills [32]: communication, teamwork, leadership, adaptability, conflict management, collaboration, professionalism, etc. are essential to a successful disaster response and management [33].
In 2016, Nieves and colleagues have presented the training framework for EMTs, suggesting key components for an operational learning methodology. In their paper, the authors highlighted the importance of a three-step approach where the team performance is a fundamental step to improve the quality of care and the patient outcomes in the field. The TEAMS project [34], aiming to develop, pilot and assess a standardized training package focused on operational team dynamics, has been created to address this specific gap in the training arena. Bodas et al. [35] have then described the effectiveness of that specific training program to improve EMTs teamwork performance.
Nevertheless, to the best of my knowledge, no study has ever examined the team dynamics performance and non-technical skills during a real mission in the field. Failures in leadership capacities and in coordination within and between teams, have been identify as disaster response problems in the qualitative study performed in 2013 by Djalali A et al. [36], but, until now, these concepts have been never assessed collecting data directly during a real disaster response. Therefore, little is known whether an EMT is able to perform as a team without a prior specific training that enhances the teamwork.
In response to this gap, a pre-test/post-test survey study was performed collecting data regarding team dynamics and non-technical skills during the Mozambique mission of the EMT2-ITA, after the Cyclone Idai in March, 2019 (see Chapter 2). The present study aims to better investigate team dynamics and non-technical skills for EMTs, trying to understand if a real mission, when the people are obliged to work together for the first time, without a prior specific training focused on teamwork, is enough or not to work as an effective team in the field.

3.1.2 Methods

Study design

This study has been designed as a pre-test/post-test survey study without control group. The objective was to evaluate the effect of a mission on the team dynamics and non-technical skills perception of the participants. The evaluation of the change (positive or negative) in the scoring on the post-test compared to the pre-test provides a vehicle for assessing if the impact of the situations, attitudes, interpersonal relationships, collaboration etc., experienced during a disaster response mission, can be sufficient to improve teamwork and not-technical skills performances or if specific training is needed.

Questionnaire design

The tools developed by Chen, Gully, and Eden [37] and by Cooper, et al.[38] were used to measure two constructs, namely self-efficacy and teamwork.
In particular, the self-efficacy questionnaire measured individual perceptions of the team's ability to perform across a variety of different situations such as achieve goals, overcome challenges and cope with difficulties (e.g.: "1. Our team will be able to achieve most of the goals that we have set for the team"); it was based on a Likert-scale ranging from 1 (strongly disagree) to 5 (strongly agree). Similarly, the teamwork questionnaire measured individual perceptions of team leadership, team dynamics, situation awareness and task management (e.g.: "1. The team leader let the team know what was expected of them through direction and command"); it was assessed using a Likert-scale ranging from 0 (never/hardly ever) to 4 (always/nearly always). In addition, the item 12 of this questionnaire prompted an overall rating about the team's non-technical performance on a scale of 1 to 10 (e.g.: 12. "On a scale of 1-10 give your global rating of the team's non-technical performance"). The complete questionnaires are available in the Annexes (A).
The variables of interest were the Self-Efficacy (SE), the Teamwork (TW) and the overall team's performance item 12 (TW_{12}) indexes, calculated as the average value of the rating given by all the participants. Finally, participants were also prompted to provide open text feedback, asking at least three things (only words or short expressions) they considered important for the successful outcome of the mission.

Data collection

The invitation to join the study was offered to the first rotation of the Italian team (56 people) deployed to Mozambique in March-May 2019 during the response to the Cyclone Idai. This constitutes the reference sample for all the analysis.
The two questionnaires were handed out by the Principal Investigator (PI) to all the participants twice, during two different moments of the mission to understand if the direct experience in the field can influence (positively or negatively) the answers:

a) before the deploy, during the journey to Mozambique, when it has been asked participants to imagine what would be happened during the mission, and

b) after the deploy, during the flight back to Italy, when it has been asked participants to remember what happened during the mission just ended.

The information collected at these two stages were considered as the "pre" and "post" data. A unique identifier (ID) was assigned to each participant to match the data to allow the cross reference of the responses without losing the anonymity. Data were collected by paper questionnaires and, then, manually entered into a Microsoft Excel spreadsheet to create an electronic database.

Data analysis

The statistical analysis of the database was performed using Stata 15.1 (StataCorp LLC, Texas, USA). Descriptive statistics were used to present data of the questionnaires and Wilcoxon signed-rank test was used to compare means of paired variables ("pre" versus "post") with a p-value of 0.05 or less deemed as statistically significant.
Thematic analysis using the coding system presented in Table 3.1 was performed to organize and compare the information provided in the open text feedback.

Ethical considerations

The study protocol was submitted to the Ethics Committee at Ospedale Maggiore della Carità in Novara and obtained its review approval (protocol number 67/CE). Team members were invited to participate in the study after a brief introduction regarding the study's objectives, during the pre-mission briefing.

Before starting the questionnaires, written informed consent was obtained from all the participants. For all subjects, it was made clear that they could withdraw from the study at any time.

Table 3.1 Coding system used in the qualitative thematic analysis of open text feedback.

Theme	**Coding system**
Adaptability	Adaptability - Flexibility - Elasticity - Mental agility - Interoperability - Versatility – Resilience
Collaboration	Collaboration – Cooperation
Communication	Communication - Dialogue - Briefing - Sharing information – Feedback
Good management	Roles - Priority - Leadership - Standard procedures - Guideline - Organization - Logistics - Achieve and share goals - Rotation with locals - To delegate - To support the team – Safety/Security
Good practice principles	Harmony - Empathy – Humility - Availability - Patience - Aid - High moral - Spirit up - Serenity - Harmony - Mutual support – Self-confidence - Working well together - Cohesion - Proactivity - Sense of belonging – Involvement - Complicity - Integration - Calm - Coordination – Respect
Personal relationships	Personal relationship - Friendship - Connection with the team
Professional competences	Professional competences – Professionalism - Technical preparation - To maintain duties

3.1.3 Results

Response rate and demographic characteristics

During the mission of EMT2-ITA in Mozambique (see Chapter 2), 55/56 staff members were selected for the study (the PI, being part of the staff members, was the data manager of the study). Fifty-one of them (response rate: 93%) completed both the questionnaires twice, before and after the deployment ("pre" and "post" data available): only these data were used for paired analysis. The missing data regarded the "post" questionnaires and were due, in particular, to three people who extended their stay and returned to their home country later, at the end of the second rotation, and to one not responding during the flight back home.
Table 3.2 shows the characteristics of the total of 55 participants. Fifty-one percent of them were male; the average age was 48 years. The team included personnel that have been previously deployed at least once to a humanitarian setting (18 people; 33%), as well as novices for whom this was their first mission (37 people; 67%); the 67% (37) of them participated to at least one European Modular Exercise (ModEx) that is a three days full scale exercise, training the teams to work in complex and stressful contexts.

Table 3.2 Characteristics of the *Team dynamics Study* participants (n = 55).

	mean (SD)
Age (years)	47.95 (9.82)
	n (%)
Gender	
F	26 (47.3%)
M	29 (52.7%)
Role	
Doctor	20 (36.4%)
Nurse	22 (40.0%)
Midwife	1 (1.8%)
X-ray Technician	1 (1.8%)
Logistic	11 (20.0%)
Experience (Previous)	
Yes	18 (32.7%)
No	37 (67.3%)
ModEx	
Yes	37 (67.3%)
No	18 (32.7%)

Self-Efficacy, teamwork and overall team's performance indexes

In the overall sample, out of a maximum score of 5, the mean score of SE was 4.012 ± 0.434 (95% CI: 3.890, 4.134) before the mission and 4.162 ± 0.655 (95% CI: 3.977, 4.346) after the deployment. The mean score of the TW, out of a maximum of 4, was 3.291 ± 0.395 (95% CI: 3.180, 3.402) before the mission and 3.334 ± 0.480 (95% CI: 3.199, 3.469) after the deployment. Finally, the global rating about the team's non-technical performance, TW_{12}, out of a maximum of 10, was 8.353 ± 1.016 (95% CI: 8.067, 8.639) before the mission and 8.549 ± 1.154 (95% CI: 8.224, 8.874) after the deployment. Even if all the differences observed are not statistically significant according to the Wilcoxon signed-rank test, a slight increase was recorded in all the scores measured.

Looking at the stratified analysis, a significant positive change for the SE (p-value = 0.004) and the TW_{12} (p-value = 0.036) for nurses and for the TW_{12} (p-value = 0.046) for participants older than 45 years old, was observed. Moreover, it was observed a positive change "almost" significant for the the SE (p-value = 0.062) and the TW (p-value = 0.056) for experienced people too. No differences were found between other categories and between men and women. The detailed results are shown in Table 3.3.

Table 3.3 Main results of the *Team dynamics Study*.

Category (n)	Index		Mean (SD)	95% C.I.	p-value
All (51)	SE	Pre	4.012 (0.434)	3.890 - 4.134	0.109
		Post	4.162 (0.655)	3.977 - 4.346	
	TW	Pre	3.291 (0.395)	3.180 - 3.402	0.425
		Post	3.334 (0.480)	3.199 - 3.469	
	TW_{12}	Pre	8.353 (1.016)	8.067 - 8.639	0.268
		Post	8.549 (1.154)	8.224 - 8.874	
Analysis by Sex					
Female (25)	SE	Pre	3.985 (0.349)	3.841 - 4.129	0.396
		Post	4.105 (0.712)	3.811 - 4.399	
	TW	Pre	3.397 (0.323)	3.264 - 3.531	0.158
		Post	3.310 (0.474)	3.114 - 3.506	
	TW_{12}	Pre	8.360 (1.114)	7.900 - 8.820	0.571
		Post	8.600 (1.118)	8.138 - 9.062	
Male (26)	SE	Pre	4.038 (0.508)	3.833 - 4.244	0.089
		Post	4.216 (0.605)	3.972 - 4.461	
	TW	Pre	3.188 (0.435)	3.013 - 3.364	0.325
		Post	3.358 (0.494)	3.158 - 3.557	
	TW_{12}	Pre	8.346 (0.936)	7.968 - 8.724	0.585
		Post	8.500 (1.208)	8.012 - 8.988	
Analysis by Age					
20 - 44 y (19)	SE	Pre	3.862 (0.408)	3.665 - 4.059	0.468
		Post	4.007 (0.696)	3.671 - 4.342	
	TW	Pre	3.137 (0.362)	2.963 - 3.312	0.324
		Post	3.047 (0.437)	2.836 - 3.258	
	TW_{12}	Pre	8.263 (0.872)	7.843 - 8.683	0.356
		Post	8.053 (1.268)	7.441 - 8.664	
> 45 y (32)	SE	Pre	4.102 (0.430)	3.947 - 4.257	0.126
		Post	4.254 (0.623)	4.029 - 4.478	
	TW	Pre	3.382 (0.390)	3.241 - 3.523	0.038*
		Post	3.505 (0.425)	3.352 - 3.658	
	TW_{12}	Pre	8.406 (1.103)	8.009 - 8.804	0.046*
		Post	8.844 (0.987)	8.488 - 9.200	

continued on next page...

*Significant (p-value ≤ 0.05 deemed as statistically significant).

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Category (n)	Index		Mean (SD)	95% C.I.	p-value
Analysis by Role					
Nurses (22)[†]	SE	Pre	4.080 (0.429)	3.889 - 4.270	0.004*
		Post	4.455 (0.525)	4.222 - 4.688	
	TW	Pre	3.370 (0.413)	3.187 - 3.553	0.261
		Post	3.463 (0.389)	3.290 - 3.635	
	TW_{12}	Pre	8.591 (0.854)	8.212 - 8.970	0.036*
		Post	9.182 (0.733)	8.857 - 9.507	
Medical Doctors (20)	SE	Pre	3.881 (0.377)	3.705 - 4.058	0.562
		Post	3.781 (0.702)	3.453 - 4.110	
	TW	Pre	3.268 (0.342)	3.108 - 3.428	0.823
		Post	3.206 (0.535)	2.955 - 3.456	
	TW_{12}	Pre	8.250 (1.164)	7.705 - 8.795	0.360
		Post	7.950 (1.394)	7.297 - 8.603	
Logisticians (9)	SE	Pre	4.139 (0.532)	3.730 - 4.548	0.553
		Post	4.292 (0.415)	3.973 - 4.610	
	TW	Pre	3.148 (0.455)	2.798 - 3.499	0.635
		Post	3.306 (0.526)	2.901 - 3.711	
	TW_{12}	Pre	8.000 (1.000)	7.231 - 8.769	0.489
		Post	8.333 (0.500)	7.949 - 8.718	
Analysis by Experience					
Experienced (16)	SE	Pre	4.000 (0.416)	3.778 - 4.222	0.062*
		Post	4.289 (0.440)	4.055 - 4.523	
	TW	Pre	3.187 (0.416)	2.965 - 3.409	0.056*
		Post	3.481 (0.462)	3.235 - 3.727	
	TW_{12}	Pre	8.313 (1.014)	7.772 - 8.853	0.159
		Post	8.813 (0.655)	8.463 - 9.162	
Novice (35)	SE	Pre	4.018 (0.448)	3.864 - 4.172	0.455
		Post	4.104 (0.732)	3.852 - 4.355	
	TW	Pre	3.338 (0.381)	3.207 - 3.469	0.687
		Post	3.268 (0.480)	3.103 - 3.432	
	TW_{12}	Pre	8.371 (1.031)	8.017 - 8.726	0.700
		Post	8.429 (1.312)	7.978 - 8.879	

[†]Including midwife and x-ray technician

*Significant or "almost" significant (p-value ≤ 0.05 deemed as statistically significant).

Open text feedback

Fifty participants reported open text feedback at least once (18 people filled only “pre” data feedback, 9 people only “post” data feedback, and 23 people both of them).
The most common (more than 50% of the occurrences) themes reported are “communication", “good management” and “good practice principles” in both “pre” and “post” data. Comparing the “post” data to the “pre” data, the trend varies according to the different themes, increasing for “good practice principles”, “personal relationships” and “professional competencies”, and decreasing for the others.
The bar chart reported in Figure 3.1 shows the detailed distribution of all the themes identified analyzing the open text feedback.

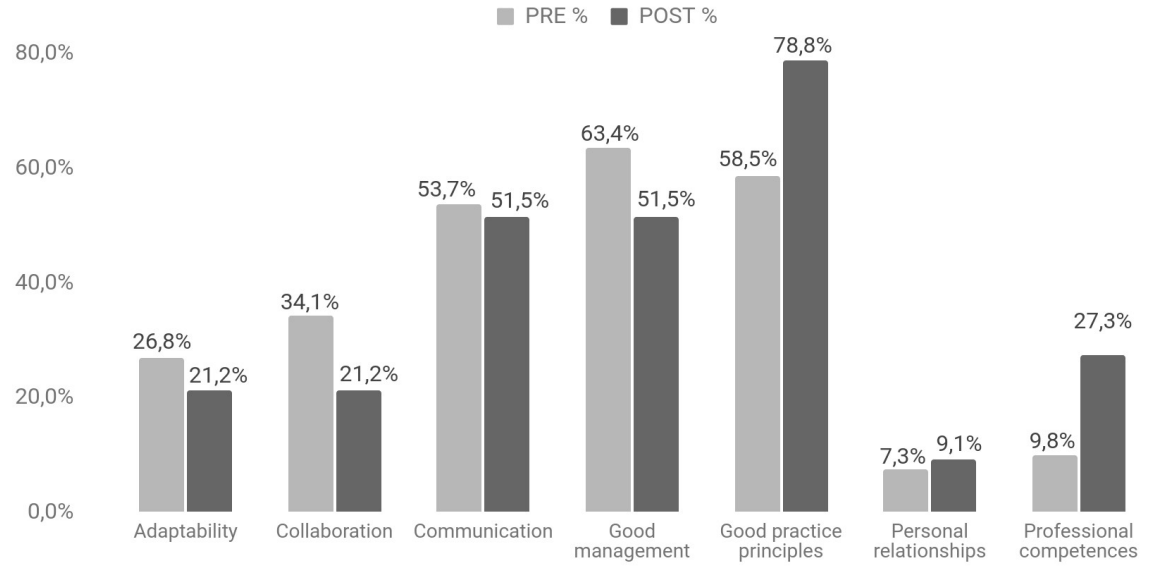

Figure 3.1 Bar chart showing the detailed distribution of all the themes reported in the open text feedback. The percentages are calculated as number of occurrences/number of available (not missing) answers.

3.1.4 Discussion

This study investigated the team dynamics and non-technical skills inside an EMT during a disaster response mission. To the best of our knowledge, no similar data are available in scientific literature until now. Teamwork and non-technical skills in disaster and emergency medicine has been previously thoroughly discussed: Bahrami et al. [28], with a qualitative study, found teamwork and communication with other team members as an essential nursing

competence in disaster response; Manser [29], in his review, demonstrated the critical importance of teamwork in assuring patient safety in highly dynamic domains of healthcare; Baker et al. [27] argued that teamwork is an essential issue of reaching high reliability, especially in health care organizations; James [30] reported the necessity for action teams to find an effective balance between task-work and teamwork to optimally respond during a disaster; finally, Willems et al. [32], in their literature review, identified different non-technical skills as essential requirements of surgeons in disaster response. Accordingly, this is the first study collecting data regarding team dynamics and non-technical skills directly in the field, during a disaster response.

The EMT2-ITA staff is not organic as the members work at different hospitals during their daily activity: even though this is an essential condition to avoid that entire medical departments at home being blocked for lack of personnel during a mission, it can be difficult, for people coming from different institutions with different protocols, to start to act as a team in a disaster setting. Moreover, for the 67% of the personnel deployed in Mozambique that was the first mission at all, and only a part of them was trained to work together during full scale exercises. Nobody attended specific training regarding teamwork and non-technical skills. Nevertheless, the indexes values were quite good, showing a moderate confidence in teamwork performance, both before and after the mission. Even though the results do not show a statistically significance, the positive trend observed comparing the "post" data to the "pre" data and the stratified analysis (per role and per age) showing a p-value less than 0.05 for SE and TW_{12} of nurses and for TW_{12} of elder team members (over 45), suggest that missions can improve both ideas and expectations of people regarding teamwork. This seems to be true for experienced people too (SE p-value = 0.062, TW p-value = 0.056). Doubtless, the issue must be investigated much more with a larger pool of people and data coming from other field experiences.
Although these positive findings seem to suggest, at a first glance, that the mission alone can be enough to effectively perform as a team, at the same time they clearly highlight the importance of specific training programs focused on teamwork. Indeed, the values of the indexes calculated from the data collected before the mission (lower than the values of the indexes calculated from the data collected after the mission) could be improved attending to training programs that have positive effects on people perception of self-efficacy and teamwork skills in the field, such as the package presented by Bodas et al. [35]: this kind of training programs could be very important to give people the opportunity to improve their confidence and feel more efficient before a real mission, contributing to the preparedness of the EMTs for future deployments.

The open text feedback provided by team members remarks the importance of teamwork and non-technical skills for the success of the mission: in particular, "communication" including

dialogue, daily briefing, and sharing information, the "good management" interpreted as definition of roles, leadership and organization, and the "good practice principles" such as empathy, patience, coordination and respect (see Table 3.1 for the coding of the themes), have been identified as key aspects for positive outcomes in the field. This is widely confirmed by the literature: for instance, in their interviews-based studies, Peller et al. [33], found inter-professionals collaboration and communication as important non-technical core competencies, while Selvaraj and Sandaran [39] stated that an effective coordination and communication are key aspects of teamwork to enhance the emergency management quality. In addition, Barelli et al. [40], in their publication "Soft skill in disaster preparedness and relief" identified communication, coordination and leadership as significant dimensions of teamwork. The variable trends observed comparing the "post" data to the "pre" data seems to suggest that the field experience can modify the perceptions of response teams, underling that people do not have a clear idea of the operational meaning of teamwork and non-technical skills: considering a variation of at least 10% of occurrences in the open text feedback, in fact, the study shows that people, imagining the following mission, highlighted the importance of "collaboration" and "good management", while, after the mission, gave more relevance to other two aspects, "good practice principles" and "professionals competences". These results confirm, one again, the need of specific training programs to increase people awareness regarding teamwork and non-technical skills.

Finally, two main limitations of this study need to be considered: the small sample size and the evaluation criteria limited to the self-perspective of the team members; further larger studies are needed to collect more data and to explore the availability of performance indicators for teamwork and non-technical skills in the field.

3.1.5 Conclusions

Teamwork and non-technical skills in general are essential issues to perform effectively in the field during disasters. According to our findings, humanitarian workers, obliged to work together for the first time without a prior specific training, feel good but not at their best: training programs focused on team working dynamics [34, 35] can be really useful to improve self-confidence of people leaving for a mission.

3.2 The *Resilience Study*

3.2.1 Introduction

The impact of disasters is strongly felt by direct and indirect victims, and may also impinge on the mental and physical health of first responders [41]. Humanitarian workers and disaster-response personnel are at considerable mental health risk given the adverse and harsh working conditions they are challenged with [42–44]. In addition to physical harm, depression, anxiety, and substance abuse are prevalent in these populations [45–47]. The staff who experiences high levels of stress (chronic or acute) may be absent more often, have less commitment to the job, may be more predisposed to be involved in accidents or have poorer decision-making skills, and may disrupt the functioning of the team [48].

Studies demonstrate that organizational support plays an important role on the mental health of humanitarian workers and first responders. Trainings, supervision, positive relationship with managers, team cohesion, and positive team support can mitigate the development of mental distress and promote well-being [46, 49]. Furthermore, it has been shown that high levels of perceived organizational support is associated with lower symptoms of anxiety, depression and Post Traumatic Stress Disorder (PTSD) among a sample of local humanitarian staff working in Sri Lanka in the aftermath of the country's civil war [50].

Resilient organizations are those that identify, adjust to and absorb variations in a way to succeed uncertainties [51, 52]. Organizational resilience could represent then the ability to survive and strengthen competencies in times of crisis [51, 53]. Regarding the work in the field of disasters and humanitarian aid, apart from being able to anticipate and prepare responses to unexpected events, organizations also need to anticipate actions to enhance mental health and teamwork. Work conditions, such as long working hours, high job demands, lack of essential material, unsafety, among others, have been identified as predictors of negative mental health outcomes [54]. Moreover, significant organizational failures happen partly because of poor team–level response to external unpredictability and low organizational resilience capacity. Therefore, regularly assessing the resilience capacity allows the organisation to identify the most vulnerable areas and to prioritize the right actions [53, 55]. Furthermore, levels of resilience are positively related to the organisation's safety [56, 57], reliability [58, 59] and competitiveness [60].

On March 2019, the tropical Cyclone Idai hit the port city of Beira, Mozambique, affecting millions of people in Mozambique, Malawi and Zimbabwe. In particular, approximately 90% of the coastal city of Beira was destroyed and in Mozambique alone, more than 600 people died among the 1.5 million affected [7]. As previously described (see Chapter 2), the EMT2-ITA

was deployed after an official request of assistance submitted from MNA to EUCPM. A group of health workers and logisticians were held responsible to set up a field hospital in the disaster zone and help the affected population in Beira.
Based on the exposed, the *Resilience Study* collected data regarding the resilience, evaluated at two levels, personal and organizational, and the perception of the support that organizations give to their employees (perceived organizational support), among the disaster-response personnel deployed to Mozambique after the hit of the Cyclone Idai in 2019. In particular, the study aims to investigate the association between the resilience and the perceived organizational support, going deeper to the different dimensions of the resilience itself.

3.2.2 Methods

Survey design

Participants were asked to answer an online survey held on the Survey Monkey (http://www.surveymonkey.com, by momentive.ai) platform, composed of demographic questions (sex, age, marital status, profession), professional experience questions (years of experience in the organization, number of previous missions, roles of responsibility, information about stress and about mental health risk, previous job incidents), and three validated tool:

1. the Perceived Organizational Support scale (POS) [61],
2. the short Benchmark Resilience Tool (BRT-13) [62] and
3. the Emergency Medical Services Resilience Scale (EMSRS) [63].

POS The POS refers to the employees' perception concerning the extent to which the organization appreciates their contribution and cares about their well-being [61, 64]. It is a 36-item questionnaire that could be used also in shorter versions: 16-item and/or 8-item short form. The 8-item form is the version adopted in this study. It is based on a 5 point Likert scale (from 1 = "completely agree" to 5 = "completely disagree").
E.g.: "The organization strongly considers my goals and values."
Completely Agree / Partially Agree / Neutral / Partially Disagree / Completely Disagree.

BRT-13 The BRT-13 is an organizational-level resilience quantification methodology that assesses behavioral traits and perceptions linked to the organization's ability to plan for, respond to and recover from emergencies and crises [62]. All the items within the BRT-13 model are

questions that assess the organizations' agreement with individual statements. BRT-13 is a self-administered questionnaire that provides organizations with an indication of their performance on 13 areas of organizational resilience. A 5 point Likert-scale (from 1 = "completely agree" to 5 = "completely disagree") has been chosen instead of the 4 point proposed by Whitman et al. [62] by analogy with the other tools used in this study (POS and EMSRS).
E.g.: "We are mindful of how a crisis could affect us."
Completely Agree / Partially Agree / Neutral / Partially Disagree / Completely Disagree.

EMSRS The EMSRS is a simple self-report scale that can be easily implemented by researchers, managers, and Emergency Medical Service (EMS) personnel [63]. It can assist emergency service managers to enhance resilience. It is composed of 31 assertions to be answered in a 5 point Likert scale (from 1 = "always" to 5 = "never").
E.g.: "I participate in missions without motivation."
Always / Often / Sometime / Rarely / Never.

The BRT-13 and the EMSRS were not available in Italian. Hence, a "forward-backwards" procedure was conducted in their translation from English to Italian. Both measures were translated into Italian (by a group of health experts) and then the Italian translation was translated back to English (by an independent group of experts). Any difference was noted and revised iteratively by both groups until the back-translation to the original was isomorphic with emphasis on conceptual and cultural equivalence.
The complete questionnaires, both in English and in Italian, are available in the Annexes (B).

Data collection

The online survey was conducted between November and December 2019. The invitation to join the study was sent to the whole Italian team (77 people) deployed to Mozambique in March-May 2019 during the response to the Cyclone Idai. This constitutes the reference sample for all the analysis.
An email introducing the study and containing the informed consent form was sent to all the Mozambique team members. Only in case of restitution of signed consent form, the PI sent the link of the online survey. A WhatsApp motivation message was sent together with the first email and, in case of missing answer, a recall message was sent after 18 days.
The electronic database exported from Survey Monkey platform was used for the statistical analysis.

Data Analysis

The statistical analysis of the results was performed using Stata 15.1 (StataCorp LLC, Texas, USA).
The factor analysis proposed by Whitman et al. [62] and Ebadi et al. [63] for BRT-13 and EMSRS respectively, is a technique traditionally used in the field of psychology that allows to reduce the large number of variables into a smaller set of factors (also referred to as dimensions). In particular, BRT-13 shows a two-factor structure (planning and adaptive capacity) while EMSRS has a six-factor structure (job motivation, self management, remaining calm, communication challenges, social support and consequence of stress).
Reverse items for EMSRS (item 3, 13, 19 and 30) and for POS (item 6 and 7) were re-coded so that a low score would indicate higher degree of personal resilience and perceived organizational support.
The type and number of items per dimension for each tool and the reverse items are reported together with the complete questionnaires in the Annexes (B).
Descriptive statistics were used to present data and non parametric Mann-Whitney test was used to compare sub-groups in a stratified analysis by variables of interest (sex, age, experience, role of responsibility) with a p-value of 0.05 or less deemed as statistically significant.
Pearson's correlation has been calculated to investigate existing relation between BRT-13 and EMSRS (per factors and overall) and POS.

Ethical considerations

The study had the approval of the Ethics Committee at the General and Legal Affairs Department of the University of Paris Descartes (protocol number TDCP - GEST-16).
Written informed consent was obtained from all the participants and for all of them it was made clear that they could withdraw from the study at any time without any consequences. The collected data were completely anonymous since no direct personal identification was required within the survey.

3.2.3 Results

Response rate and demographic and professional characteristics

The staff of the EMT2-ITA deployed in Mozambique in 2019 included 77 team members, comprising both medical professionals (physicians, nurses, xray tech, midwife) and not medical

people (electricians, water experts, logisticians). Forty-three of them (response rate: 56%) completed the whole survey (demographic and professional questions, POS, BRT-13 and EMSRS), one of them did not finish the survey and was excluded from the analysis, 33 of them did not respond to the invitation to the study.
Table 3.4 shows the characteristics of the total of 43 participants. Fifty-six percent of them were female; the 51% were younger than 50 years old. Almost the total of the participants (39 people; 91%) had less than 5 years of seniority in the organization and the 88% (38) of them were deployed at least 1-2 times to a humanitarian mission; the majority of them (34 people; 79%) had never covered a responsibility role inside the organization.

The POS, BRT-13 and EMSRS scores

The descriptive statistics for the POS, the overall resilience scores BRT-13 and EMSRS, and each of the resilience factors are shown in Table 3.5. Out of a maximum of 5, the average score of the POS was 1.99 ± 0.56 (95% CI: 1.82, 2.16), of the BRT-13 was 1.76 ± 0.45 (95% CI: 1.62, 1.90) and of the EMSRS was 2.32 ± 0.30 (95% CI: 2.23, 2.41). The planning factor earned lower scores (mean = 1.62; standard deviation = 0.46) than the adaptive capacity factor (mean = 1.83; standard deviation = 0.61). Regarding the EMSRS, an average score lower than 2 were recorded for self management and social support factors.
Looking at the stratified analysis, reported in detail in Table 3.6, a significant difference (p-value = 0.01) has been observed between people holding or not responsibility roles for the BRT-13 factor of planning. An “almost” (p-value = 0.06) significant differences have been observed between young and elder people for the EMSRS factor of self management. No additional differences between the analyzed categories were found for POS and for the other factors of BRT-13 and EMSRS.

Table 3.4 Demographic and professional experience characteristics of the *Resilience Study* participants (n = 43).

	n (%)
Age	
20 - 29 y	1 (2.3%)
30 - 39 y	7 (16.3%)
40 - 49 y	14 (32.6%)
50 - 59 y	17 (39.5%)
$>$ 60	4 (9.3%)
Gender	
F	24 (55.8%)
M	19 (44.2%)
Marital Status	
Married	26 (60.5%)
Widowed	0 (0.0%)
Divorced	4 (9.3%)
Single	7 (16.3%)
Unmarried couple	6 (14.0%)
Period working in the organization (seniority)	
Less than 1 year	5 (11.6%)
1-3 years	21 (48.8%)
3-5 years	13 (30.2%)
5-8 years	1 (2.3%)
More than 8 years	3 (7.0%)
Number of times deployed (experience)	
1-2 times	38 (88.4%)
2-4 times	4 (9.3%)
5-7 times	1 (2.3%)
Last time deployed	
Less than 1 year ago	43 (100.0%)
Responsibility Role	
Yes	9 (20.9%)
No	34 (79.1%)
Stress information	
Yes	25 (58.1%)
No	18 (41.9%)
Psychosocial information	
Yes	34 (79.1%)
No	1 (2.3%)
Partially	8 (18.6%)
Job incident on mission	
Yes	4 (9.1%)
If *Yes*, did you feel supported by organization?	
Yes	3 (75.0%)
Partially	1 (25.0%)
No	39 (90.7%)

Table 3.5 Descriptive statistics (per factors and overall) for all the participants (n = 43).

	Mean (SD)	**95% C.I.**
POS	1.99 (0.56)	1.82 - 2.16
BRT-13 (# items per factor)		
Planning (5)	1.62 (0.46)	1.48 - 1.77
Adaptive capacity (8)	1.83 (0.61)	1.64 - 2.01
Overall organizational resilience	1.76 (0.45)	1.62 - 1.90
EMSRS (# items per factor)		
Job motivation (13)	2.09 (0.33)	1.99 - 2.20
Self management (5)	1.87 (0.62)	1.68 - 2.06
Remaining calm (5)	2.55 (0.58)	2.37 - 2.73
Communication challenges (3)	2.56 (0.46)	2.41 - 2.70
Social support (2)	1.84 (0.64)	1.64 - 2.03
Consequence of stress (3)	3.75 (0.26)	3.67 - 3.83
Overall personal resilience	2.32 (0.30)	2.23 - 2.41

Table 3.6 Stratified analysis by variables of interest (per factors and overall) for all the participants (n = 43). P-value associated to the non parametric Mann-Whitney test for comparison of sub-groups; descriptive statistics (mean and SD) reported for completeness.

	Category	Mean (SD)	95% C.I.	p-value
Analysis by Sex				
POS	Female	1.96 (0.62)	1.70 - 2.22	0.62
	Male	2.02 (0.49)	1.78 - 2.26	
BRT-13 (# items per factor)				
Overall (13)	Female	1.66 (0.43)	1.50 - 1.87	0.21
	Male	1.86 (0.48)	1.63 - 2.09	
Planning (5)	Female	1.57 (0.34)	1.42 - 1.71	0.69
	Male	1.69 (0.59)	1.41 - 1.98	
Adaptative Capacity (8)	Female	1.74 (0.60)	1.49 - 2.00	0.36
	Male	1.93 (0.62)	1.63 - 2.23	
EMSRS (# items per factor)				
Overall (31)	Female	2.31 (0.32)	2.18 - 2.45	0.54
	Male	2.33 (0.30)	2.23 - 2.41	
Job motivation (13)	Female	2.08 (0.36)	1.92 - 2.23	0.25
	Male	2.11 (0.29)	1.97 - 2.25	
Self management (5)	Female	1.79 (0.53)	1.57 - 2.01	0.53
	Male	1.97 (0.72)	1.62 - 2.32	
Remaining calm (5)	Female	2.51 (0.58)	2.26 - 2.75	0.38
	Male	2.60 (0.60)	2.31 - 2.89	
Communication challenges (3)	Female	2.67 (0.54)	2.44 - 2.89	0.09
	Male	2.42 (0.31)	2.27 - 2.57	
Social support (2)	Female	1.89 (0.71)	1.60 - 2.19	0.70
	Male	1.76 (0.56)	1.49 - 2.03	
Consequence of stress (3)	Female	3.82 (0.26)	3.71 - 3.93	0.10
	Male	3.67 (0.25)	3.55 - 3.79	
Analysis by Age				
POS	20-49 y	1.88 (0.47)	1.67 - 2.09	0.24
	> 50 y	2.10 (0.63)	1.81 - 2.39	
BRT-13 (# items per factor)				
Overall (13)	20-49 y	1.79 (0.48)	1.575 - 2.00	0.72
	> 50 y	1.73 (0.43)	1.54 - 1.93	
Planning (5)	20-49 y	1.70 (0.52)	1.47 - 1.93	0.36
	> 50 y	1.54 (0.39)	1.36 - 1.72	

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	Category	Mean (SD)	95% C.I.	p-value
Adaptative Capacity (8)	20-49 y	1.81 (0.56)	1.56 - 2.05	0.89
	> 50 y	1.84 (0.68)	1.54 - 2.15	
EMSRS (# items per factor)				
Overall (31)	20-49 y	2.36 (0.35)	2.21 - 2.51	0.69
	> 50 y	2.28 (0.24)	2.17 - 2.38	
Job motivation (13)	20-49 y	2.07 (0.41)	1.89 -2.25	0.27
	> 50 y	2.11 (0.23)	2.01 - 2.22	
Self management (5)	20-49 y	2.05 (0.73)	1.72 - 2.37	0.06*
	> 50 y	1.69 (0.42)	1.49 - 1.88	
Remaining calm (5)	20-49 y	2.69 (0.66)	2.31 - 2.89	0.39
	> 50 y	2.49 (0.50)	2.27 - 2.72	
Communication challenges (3)	20-49 y	2.58 (0.53)	2.34 - 2.81	0.92
	> 50 y	2.54 (0.40)	2.36 - 2.72	
Social support (2)	20-49 y	1.95 (0.57)	1.70 - 2.21	0.12
	> 50 y	1.71 (0.70)	1.40 - 2.03	
Consequence of stress (3)	20-49 y	3.79 (0.28)	3.66 - 3.91	0.25
	> 50 y	3.71 (0.24)	3.60 - 3.82	
Analysis by Experience				
POS	1-2 missions	1.94 (0.50)	1.78 - 2.11	0.25
	> 2 missions	2.32 (0.41)	1.19 - 3.46	
BRT-13 (# items per factor)				
Overall (13)	1-2 missions	1.73 (0.42)	1.60 - 1.87	0.28
	> 2 missions	2.01 (0.67)	1.19 - 2.84	
Planning (5)	1-2 missions	1.60 (0.43)	1.46 - 1.74	0.59
	> 2 missions	1.80 (0.74)	0.89 - 2.71	
Adaptative Capacity (8)	1-2 missions	1.78 (0.53)	1.61 - 1.96	0.59
	> 2 missions	2.15 (1.09)	0.80 - 3.50	
EMSRS (# items per factor)				
Overall (31)	1-2 missions	2.33 (0.30)	2.23 - 2.43	0.48
	> 2 missions	2.24 (0.26)	1.92 - 2.56	
Job motivation (13)	1-2 missions	2.08 (0.34)	1.97 - 2.20	0.49
	> 2 missions	2.15 (0.19)	1.92 - 2.39	
Self management (5)	1-2 missions	1.88 (0.65)	1.67 - 2.10	0.98
	> 2 missions	1.76 (0.30)	1.39 - 2.13	
Remaining calm (5)	1-2 missions	2.59 (0.57)	2.41 - 2.78	0.10
	> 2 missions	2.20 (0.58)	1.48 - 2.92	

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*Significant or "almost" significant (p-value ≤ 0.05 deemed as statistically significant).

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	Category	Mean (SD)	95% C.I.	p-value
Communication challenges (3)	1-2 missions	2.58 (0.46)	2.43 - 2.73	0.20
	> 2 missions	2.40 (0.55)	1.72 - 3.08	
Social support (2)	1-2 missions	1.84 (0.59)	1.65 - 2.04	0.51
	> 2 missions	1.80 (1.04)	0.51 - 3.09	
Consequence of stress (3)	1-2 missions	3.77 (0.22)	3.70 - 3.84	0.21
	> 2 missions	3.60 (0.49)	2.99 - 4.21	
Analysis by Responsibility Role				
POS	Yes	2.26 (0.69)	1.73 - 2.79	0.11
	No	1.91 (0.51)	1.74 - 2.09	
BRT-13 (# items per factor)				
Overall (13)	Yes	1.71 (0.57)	1.27 - 2.15	0.44
	No	1.78 (0.43)	1.63 - 1.92	
Planning (5)	Yes	1.31 (0.20)	1.15 - 1.46	0.01*
	No	1.71 (0.48)	1.54 - 1.87	
Adaptative Capacity (8)	Yes	2.04 (0.95)	1.31 - 2.77	0.76
	No	1.77 (0.49)	1.60 - 1.94	
EMSRS (# items per factor)				
Overall (31)	Yes	2.32 (0.23)	2.15 - 2.50	0.79
	No	2.32 (0.32)	2.21 - 2.43	
Job motivation (13)	Yes	2.06 (0.36)	1.79 - 2.34	0.89
	No	2.10 (0.33)	1.99 - 2.21	
Self management (5)	Yes	1.69 (0.41)	1.37 - 2.01	0.37
	No	1.92 (0.66)	1.69 - 2.15	
Remaining calm (5)	Yes	2.53 (0.43)	2.20 - 2.87	0.81
	No	2.55 (0.62)	2.34 - 2.77	
Communication challenges(3)	Yes	2.70 (0.39)	2.40 - 3.00	0.15
	No	2.52 (0.48)	2.35 - 2.69	
Social support (2)	Yes	2.11 (0.70)	1.57 - 2.65	0.12
	No	1.76 (0.62)	1.55 - 1.98	
Consequence of stress (3)	Yes	3.89 (0.29)	3.67 - 4.11	0.13
	No	3.72 (0.25)	3.63 - 3.80	

*Significant or "almost" significant (p-value ≤ 0.05 deemed as statistically significant).

Correlations between the POS and the BRT-13 and EMSRS were assessed at the overall resilience score and at the factor levels. As shown in Table 3.7, the POS and BRT-13 strongly correlate ($r^2 = 0.69$) for the overall organizational score, whit a weak/moderate correlation ($r^2 = 0.35$) for planning factor and a strong correlation for the adaptive capacity factor ($r^2 = 0.71$). All these correlations are statistically significant (p-values ≤ 0.05). Regarding the EMSRS, the analyses show a weak significant correlation ($r^2 = 0.3$, p-value = 0.05) only for the first factor, job motivation.

Table 3.7 Pearson correlation coefficients (r^2) for the relation between perceived organizational support (POS) and organizational (BRT-13) and personal (EMSRS) resilience.

	POS	
	r^2	**p-value**
BRT-13 (# items per factor)		
Planning (5)	0.35	0.02*
Adaptive capacity (8)	0.71	0.00*
Overall organizational resilience	0.69	0.00*
EMSRS (# items per factor)		
Job motivation (13)	0.30	0.05*
Self management (5)	-0.14	0.38
Remaining calm (5)	0.21	0.17
Communication challenges (3)	0.11	0.48
Social support (2)	0.13	0.42
Consequence of stress (3)	-0.03	0.83
Overall personal resilience	0.19	0.22

*Significant (p-value ≤ 0.05 deemed as statistically significant)

3.2.4 Discussion

This study collected data about resilience and perceived organizational support among the personnel deployed to a disaster mission (Mozambique 2019), analyzing the mean scores reported, possible differences between categories of respondents and, above all, the association between these two important concepts.

The low values recorded for the three scores reveal a positive outcome of the EMT2-ITA about the core themes of this survey study: POS shows good people's perception concerning the value given by the organization to their contributions and their well-being; BRT-13 indicates adequate organizational resilience, especially regarding the ability of the organization to adapt to emergencies and crisis; EMSRS suggests sufficient personal resilience, especially regarding

the individuals' ability to manage their behaviors and performances and the support between colleagues. The stratified analysis, by responsibility role and age, enhances some interesting differences: people holding responsibility roles shows high attitudes to plan (i.e. higher organizational resilience); people older than 50 years better managed their behaviors (i.e. higher personal resilience). According to these findings, literature reports age and gender as the demographic variables most frequently connected to personal resilience [65]. Although different studies reported mixed findings regarding the relationship between resilience, age and sex, most of them have shown a positive association [53]: elder male people seem to be more resilient. In addition, Curling and Simmons [66], in their survey study conducted in 2009 by a large international aid organization, found that female staff reported higher levels of stress than males, arising from conflicting demands of work and family duties, as well as from gender-based discrimination, harassment and security social restrictions on women that were presents in some emergency context. Even if the study results do not enhance significant differences between genders, the p-value recorded for consequences of stress (0.10) seems to confirm these findings: further studies are needed to better investigate this aspect.

Then, the *Resilience Study* findings reveal an association between POS and the organizational resilience, assessed with BRT-13, but not with the personal resilience, assessed with EMSRS. This seems to be meaningful because a resilient organization, intended as an organization able to plan for and to adapt to sudden emergencies, crisis and disasters, can provide support to its employees; otherwise, the personal resilience is an individual quality, a natural feature, a personality trait [65] and it refers to a person's ability to withstand, adapt to, and recover from adversity [67]: one person can be highly resilient regardless of the support received by his/her organization. Nevertheless, for the job motivation, which includes some issues linked to the support provided by the organizations to their employees, the results enhanced a weak correlation, confirming the existing positive relationship found by Maan and colleagues in their study [68].

Finally, the main limitation of the present study regards the specific pool of participants, restricted only to the EMT2-ITA deployed to Mozambique in 2019: doubtless, if the survey study will be extended to other organizations and disaster-response teams, it would be possible to try to reach more powerful and generalized conclusions. Moreover, the results were obtained from a single method of measurement with self-assessment questionnaires: future studies would also benefit from the application of other data collection techniques, such as interviews, focus groups and observations.

3.2.5 Conclusions

The study showed a good resilience, both organizational and personal, and a good perceived organizational support for the team deployed in Mozambique in 2019, with a positive attitude to plan at organizational level especially for people who held responsibility roles, with lower consequences of stress especially for men and a better self management behaviors especially for elder people. Above all, the study revealed a strong association between the organizational resilience and the perceived organizational support, that can be an useful information for managers to start or continue to invest in this direction.

Chapter 4

Recovery phase - *The Beira Triage System (BeTS) Study*

This chapter is based on:

Andrea Conti, Daniela Sacchetto, Giovanni Putoto, Marcello Mazzotta, Giovanna De Meneghi, Emanuela De Vivo, Lorenzo Lora Ronco, Ives Hubloue, Francesco Della Corte, Francesco Barone-Adesi, Luca Ragazzoni and Marta Caviglia. Assessment of the South African Triage Scale (SATS) in a new ambulance system in Beira, Mozambique. *International Journal of Environmental Research and Public Health*, 19(16):1–12, August 2022. doi:10.3390/ijerph191610298.

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4.1 Introduction

In LMICs formal ERS rarely exists, and when present, are often hampered by structural inefficiencies such as poor transportation and infrastructure, shortage of skilled medical staff and resources, and lack of comprehensive referral protocols [69, 70]. To address the transportation

gap, many non-governmental organizations (NGOs) working in LMICs have implemented ERS at local or regional level, using different means of transport including even motorbike and bicycle ambulances [71–73]. Nonetheless, the absence of well-established protocols for patient transfer frequently leads to the inappropriate transport of uncomplicated cases to referral hospitals, overwhelming their personnel and impacting on the already scarce resources available [74, 75]. In this scenario, the implementation of patient prioritization strategies becomes pivotal in managing the challenges associated with the existing mismatch between the demand of emergency care and the available resources, thus avoiding the inappropriate use of national referral hospitals and all the consequences associated with it. While prehospital triage criteria for patient transport are frequently adopted in upper-middle and high income countries [76], there is currently a lack of scientific literature on the implementation of triage systems in LMICs' prehospital settings, and no consensus on which triage tool works better in these contexts has been achieved yet [77, 78]. More broadly, only recently LMICs have started incorporating triage tools into emergency department practice, by either adapting existing protocols or by implementing new tools such as the SATS [8–10]. SATS, a triage protocol expressly designed for LMICs, is a four-level triage algorithm based on a list of emergency conditions and on the evaluation of seven different vital signs (mobility, respiratory rate, heart rate, systolic blood pressure, temperature, neurologic status, and history of a trauma). Using three different tables (for adults, younger, and older children) containing reference values, the so-called Triage Early Warning Score (TEWS) is calculated. Patients who present one of the predetermined emergency conditions are immediately classified within the maximum priority category ("red"), while others have SATS codes assigned according to the TEWS [8]. The use of objective vital signs data makes the SATS a robust, simple and rapid tool to be taught to inexperienced staff [79, 80]. While the use of SATS has been extensively validated in different emergency departments located in resource-constrained settings, effectively reducing patients' waiting time, hospital length of stay, and mortality [10, 79–86], its performance in the prehospital field and in the assessment of non-trauma cases has not been thoroughly evaluated so far. Indeed, the formal assessment of the SATS utilization by prehospital providers has been performed only through indirect methodologies, such as written clinical vignettes or focus group discussions [87–89].

SATS has been recently integrated in the urban ambulance system of Beira (Mozambique), established immediately after the 2019 Cyclone Idai by the NGO Doctors with Africa CUAMM (Padova, Italy) in collaboration with the Center for Research and Training in Disaster Medicine, Humanitarian Aid, and Global Health (CRIMEDIM, Università del Piemonte Orientale, Novara, Italy). The 24/7 free-of-charge referral service started its activities on June 1st, 2019, linking the CHB with 15 peripheral HCs through a fleet of five ambulances stationed in five different

HCs, selected according to their geographical position and to the number of patients treated per day (Figure 4.1). Upon its inception, the service did not contemplate a standardized prioritization protocol for patient referral, but rather followed a "first-in-first-out" approach, thus often leading to a saturation of the service's referral capacity. Therefore, SATS has been incorporated to improve referrals and regulate the number of severe cases accessing to the CHB from the three HCs of Chingussura, Munhava and Manga Mascarenhas. From November 27th to November 30th, 2019, 75 nurses working in the abovementioned HCs were trained on the use of SATS and instructed to refer patients when deemed necessary according to the priority codes. Specifically, nurses underwent a single two-day course (Table 4.1) and were instructed to follow a specific protocol for patient transport from the three HCs to the HCB (Figure 4.2). To date, this is the first example of SATS integration and assessment within the referral protocol of an urban ambulance system in a low-income country. The purpose of this study was to assess whether the implementation of the SATS improved the selection process for acute patients' referral from HCs to the HCB. In addition, the validity (i.e., triage accuracy) of SATS when used by nurses in the HCs has been assessed.

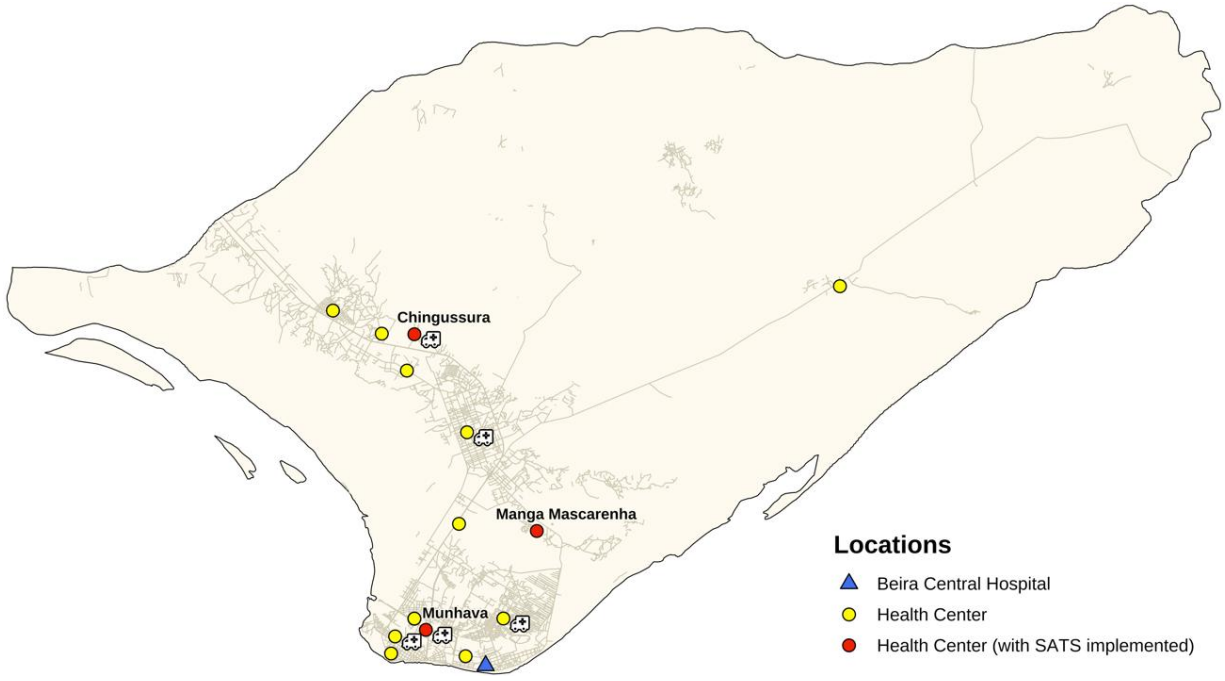


Figure 4.1 Distribution of Health Centres (HCs) and ambulances in Beira.

Table 4.1 SATS course agenda and learning objectives.

Agenda		
Slots (1 hour each)	**Day 1**	**Day 2**
Slot 1	Introduction to the course and pre-test	Introduction to adult and paediatric SATS triage
Slot 2	Introduction to basic principles of triage	Exercise on SATS (adult and paediatric)
Slot 3	Introduction to the proposed referral protocol	Data collection and referral chart use
Slot 4	Vital signs (reference values, how to measure them, meaning of abnormal values)	Exercise on SATS (adult and paediatric)
Slot 5	Introduction to the SATS	Post-test and feedback questionnaire

Learning Objectives

- To acquire basic principles of triage
- To acquire the ability to measure and to understand vital signs
- To understand the importance of patients' prioritization
- To understand the newly implemented referral protocol
- To learn how to apply the SATS to both adult and paediatric patients
- To acquire the ability to collect data using the referral chart

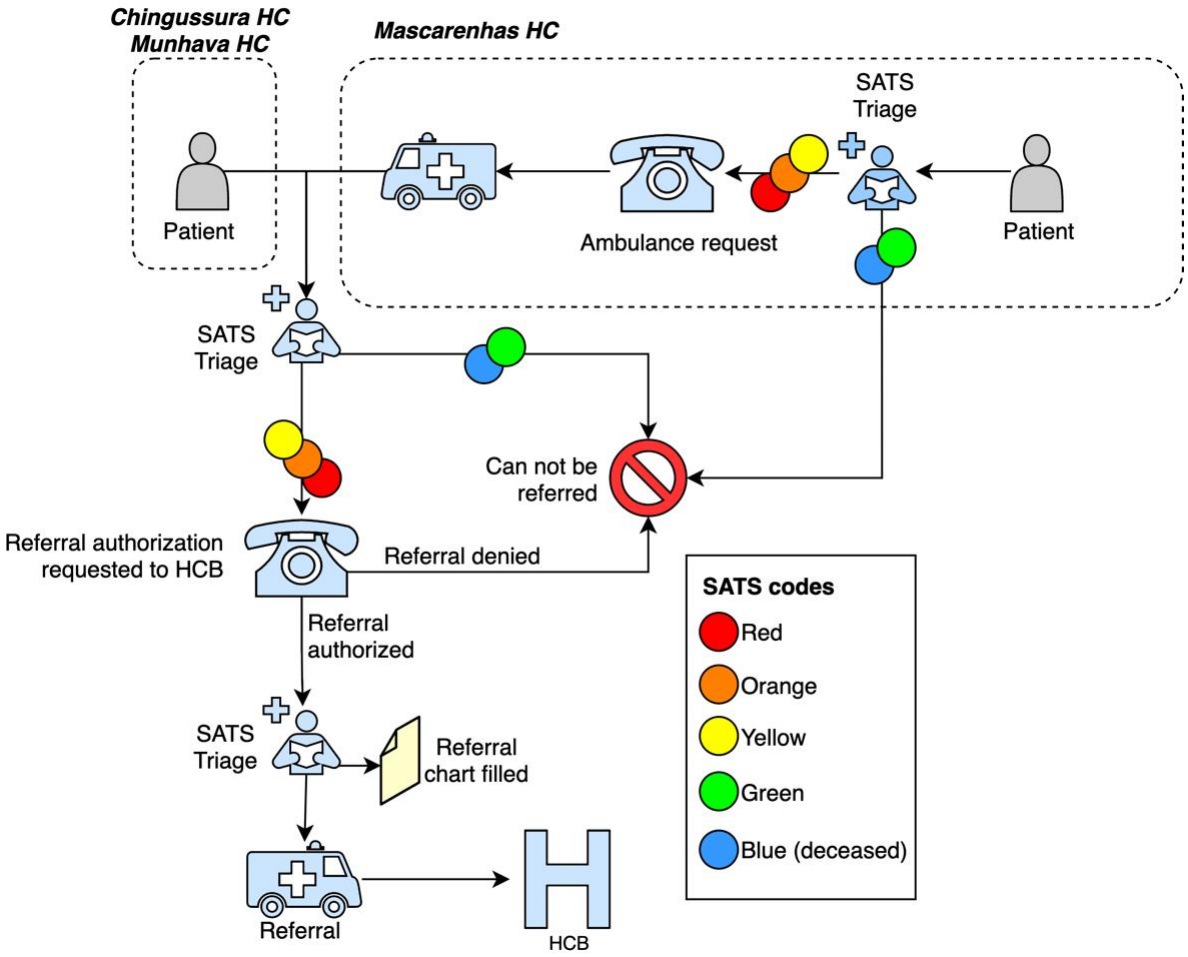


Figure 4.2 Dispatch protocol.

4.2 Methods

Study design

This was a retrospective observational study that included all the referral transports performed from the October 8th, 2019, to June 1st, 2020, from the three HCs of Chingussura, Manga Mascarenhas, and Munhava to the CHB. The study consisted of two consecutive phases: a pre- implementation phase (from October 8th, 2019, to December 7th, 2019), during which the assessment of patients and their subsequent referral to the CHB did not involve the use of SATS, and a post-implementation phase (from December 8th, 2019, to June 1st, 2020) involving the use of SATS.

Study setting

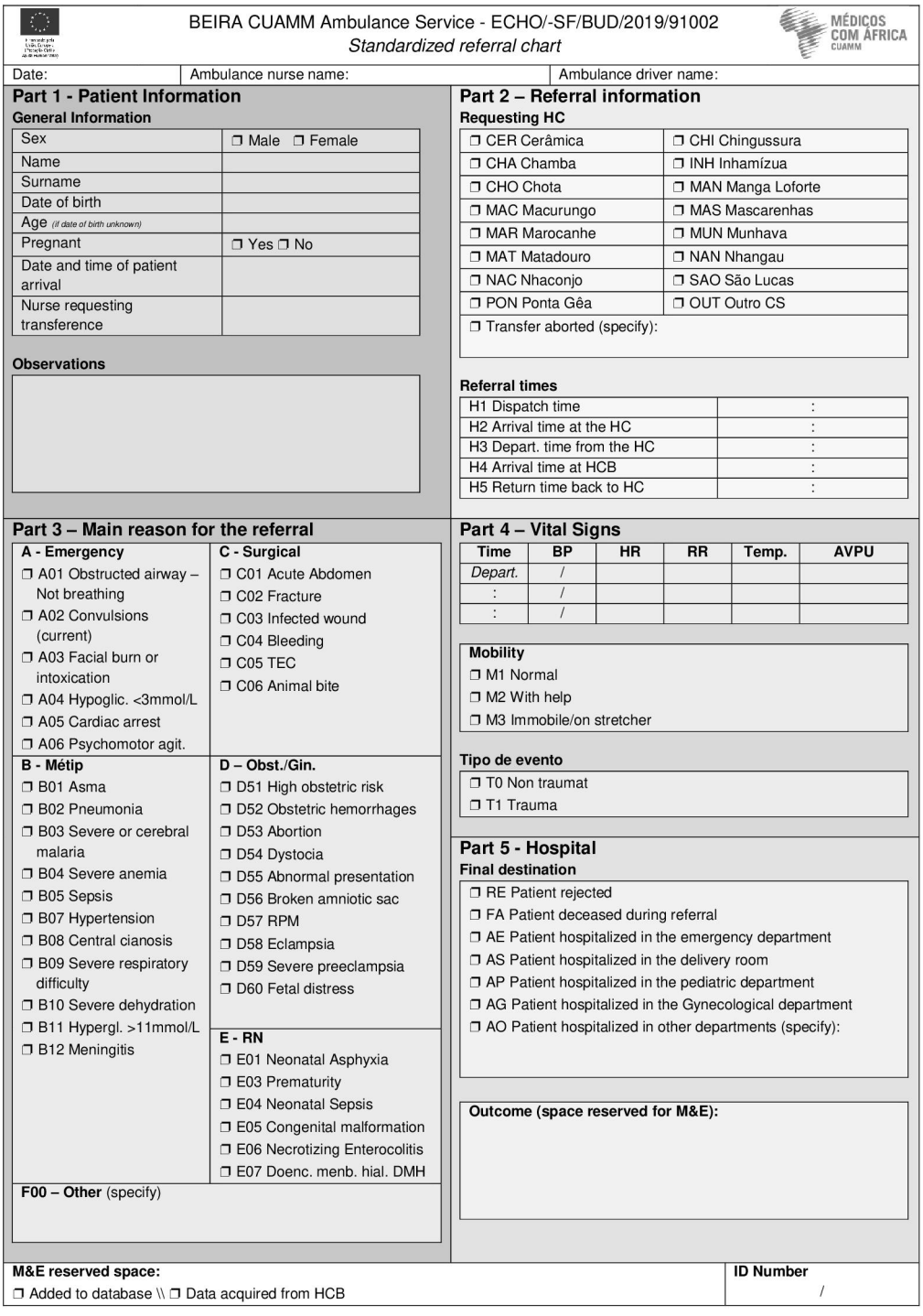
Chingussura and Munhava HCs are classified as "Urban type A Health Centres" and are designed to serve a population of 40,000-100,000 inhabitants within a 1-4 km range. They are respectively located at 18 km and 6.5 km of distance from the CHB, and each one is equipped with one ambulance immediately available for referrals. The HC of Manga Mascarenhas is classified as a "Urban Type B Health Center", assisting 18,000-40,000 inhabitants within a 2-4 km range. It is 9.5 km far from the CHB and served by one ambulance stationed in the HC of Macurungo (at 8 km of distance), available upon request via phone call. Both types of urban HCs are designed to provide ambulatory basic services, such as general adult and paediatric examination, basic laboratory tests, and drug administration, while they cannot provide long-term patient hospitalization, specialized consultation, surgery procedures, or advanced emergency cares [90]. In the post-implementation phase, nurses in the three HCs were instructed to refer to the CHB both trauma and medical cases triaged with "yellow", "orange" and "red" codes, while minor "green" codes had to be treated at the HCs level (Figure 4.2).

Data collection

An electronic database stored all information recorded by trained nurses during transport using a patient's referral chart (Figure 4.3). After collecting patients' referral charts at the CHB, dedicated local personnel trained by CUAMM performed data entry in this electronic database. Data accuracy has been monitored through weekly inspections by CUAMM supervisors. Variables extracted for the present analysis included sex, age, disease category (medical, surgical, paediatric, obstetric/gynaecological), nurse-assigned priority codes (green, yellow, orange, red), and vital signs. Data were anonymized, and incomplete records were excluded.

Data analysis

Researchers from CRIMEDIM retrospectively assessed the expected triage code for all patients transported during the pre-implementation and post-implementation phases using the SATS protocol. The researchers were blinded to the time of the charts (pre and post implementation phases) to avoid bias. To evaluate variation in the pattern of acute patients referred, expected codes of patients transported to the CHBs before and after the implementation of SATS was compared. Chi-square test was used to evaluate changes in the proportion of the different expected triage code.



BEIRA CUAMM Ambulance Service - ECHO/-SF/BUD/2019/91002
Standardized referral chart

MÉDICOS COM ÁFRICA CUAMM

Date:	Ambulance nurse name:	Ambulance driver name:

Part 1 - Patient Information

General Information

Sex	❒ Male ❒ Female
Name	
Surname	
Date of birth	
Age *(if date of birth unknown)*	
Pregnant	❒ Yes ❒ No
Date and time of patient arrival	
Nurse requesting transference	

Observations

Part 2 – Referral information

Requesting HC

❒ CER Cerâmica	❒ CHI Chingussura
❒ CHA Chamba	❒ INH Inhamízua
❒ CHO Chota	❒ MAN Manga Loforte
❒ MAC Macurungo	❒ MAS Mascarenhas
❒ MAR Marocanhe	❒ MUN Munhava
❒ MAT Matadouro	❒ NAN Nhangau
❒ NAC Nhaconjo	❒ SAO São Lucas
❒ PON Ponta Gêa	❒ OUT Outro CS
❒ Transfer aborted (specify):	

Referral times

H1 Dispatch time	:
H2 Arrival time at the HC	:
H3 Depart. time from the HC	:
H4 Arrival time at HCB	:
H5 Return time back to HC	:

Part 3 – Main reason for the referral

A - Emergency
- ❒ A01 Obstructed airway – Not breathing
- ❒ A02 Convulsions (current)
- ❒ A03 Facial burn or intoxication
- ❒ A04 Hypoglic. <3mmol/L
- ❒ A05 Cardiac arrest
- ❒ A06 Psychomotor agit.

C - Surgical
- ❒ C01 Acute Abdomen
- ❒ C02 Fracture
- ❒ C03 Infected wound
- ❒ C04 Bleeding
- ❒ C05 TEC
- ❒ C06 Animal bite

B - Métip
- ❒ B01 Asma
- ❒ B02 Pneumonia
- ❒ B03 Severe or cerebral malaria
- ❒ B04 Severe anemia
- ❒ B05 Sepsis
- ❒ B07 Hypertension
- ❒ B08 Central cianosis
- ❒ B09 Severe respiratory difficulty
- ❒ B10 Severe dehydration
- ❒ B11 Hypergl. >11mmol/L
- ❒ B12 Meningitis

D – Obst./Gin.
- ❒ D51 High obstetric risk
- ❒ D52 Obstetric hemorrhages
- ❒ D53 Abortion
- ❒ D54 Dystocia
- ❒ D55 Abnormal presentation
- ❒ D56 Broken amniotic sac
- ❒ D57 RPM
- ❒ D58 Eclampsia
- ❒ D59 Severe preeclampsia
- ❒ D60 Fetal distress

E - RN
- ❒ E01 Neonatal Asphyxia
- ❒ E03 Prematurity
- ❒ E04 Neonatal Sepsis
- ❒ E05 Congenital malformation
- ❒ E06 Necrotizing Enterocolitis
- ❒ E07 Doenc. menb. hial. DMH

F00 – Other (specify)

Part 4 – Vital Signs

Time	BP	HR	RR	Temp.	AVPU
Depart.	/				
:	/				
:	/				

Mobility
- ❒ M1 Normal
- ❒ M2 With help
- ❒ M3 Immobile/on stretcher

Tipo de evento
- ❒ T0 Non traumat
- ❒ T1 Trauma

Part 5 - Hospital

Final destination
- ❒ RE Patient rejected
- ❒ FA Patient deceased during referral
- ❒ AE Patient hospitalized in the emergency department
- ❒ AS Patient hospitalized in the delivery room
- ❒ AP Patient hospitalized in the pediatric department
- ❒ AG Patient hospitalized in the Gynecological department
- ❒ AO Patient hospitalized in other departments (specify):

Outcome (space reserved for M&E):

M&E reserved space:
❒ Added to database \\ ❒ Data acquired from HCB

ID Number /

Figure 4.3 Patient's referral chart - English translation: the original chart was developed and implemented in Portuguese.

SATS overall accuracy was assessed comparing nurse-assigned codes to expected codes, the latter being used as gold-standard. The assumption is that CRIMEDIM researchers who know the triage method very well applied it by textbook; on the other hand local nurses who are novice to it should have experienced a training curve. Under and over-triage was defined when nurse-assigned codes were lower or higher than the gold-standard, respectively. The proportion of mis-triage was defined as the sum of the observed proportions of under-triage and over-triage. Logistic regression was used to investigate the possible association between triage accuracy of each referral, coded as a dichotomous variable (matching or not matching the expected code) and gender, age, and time since implementation of SATS (independent variables). In all statistical analyses, a p-value of 0.05 or less was deemed as statistically significant. The data analysis was performed using Stata 15 (StataCorp. 2017. College Station, Texas, US).

Ethical considerations

Patients and the public were not involved in the design of this study and in the dissemination plans of this research.
The study protocol was submitted to the Ethics Committee at Ospedale Maggiore della Carità in Novara and obtained its review approval (protocol number 723/CE).

4.3 Results

During the observation period, a total of 2,636 referral charts were collected. Four-hundred-seventy-six incomplete records (18.1% of the total), for which it was not possible to retrospectively calculate the SATS code, were excluded from the analysis. Table 4.2 summarizes the demographic information of considered patients. The analysis included a total of 552 and 1,608 referral charts for the pre- and post-implementation phases, respectively. Referral rate did not change appreciably overtime (9.2 average referrals per day in both phases). In both phases, referred patients were mainly women and most of the referrals regarded obstetric/gynaecologic and paediatric complaints (Table 4.2).

Table 4.2 Demographic information of referred patients, before and after SATS implementation.

	Pre-implementation	**Post-implementation**
	n (%)	**n (%)**
Sex		
Male	171 (30.0%)	474 (29.5%)
Female	381 (70.0%)	1,134 (70.5%)
Pregnant	183 (48.0%)	609 (53.7%)
SATS age classes		
0-2 years (younger child)	88 (15.9%)	270 (16.8%)
3-12 (older child)	68 (12.3%)	147 (9.1%)
12+ (adult)	396 (71.7%)	1,191 (74.1%)
Health Center		
Chingussura	356 (64.5%)	827 (51.4%)
Manga Mascarenhas	79 (14.3%)	177 (11.0%)
Munhava	117 (21.2%)	604 (37.6%)
Disease Category		
Medical	97 (17.6%)	332 (20.7%)
Obstetric/Gyn.	141 (25.5%)	652 (40.6%)
Paediatric	118 (21.4%)	422 (26.2%)
Surgical	57 (10.3%)	202 (12.6%)
Missing	139 (25.2%)	0 (0.0%)
Total	552	1,608
Observation time (days)	60	175
Transport rate (patients/day)	9.2	9.2

After the implementation of SATS there was an increase of orange and red codes (+12.2%; +12.9% respectively) and a reduction of green and yellow codes (-18.7%; -5.8%, respectively) referred to the CHB (Table 4.3). Figure 4.4 shows how this phenomenon took place gradually and lasted for the whole study period.

Table 4.3 Expected codes of referred patients, before and after SATS implementation.

Code	Pre-implementation	Post-implementation	
	n (%)	n (%)	p-value
Green	174 (31.5%)	206 (12.8%)	<0.05
Yellow	181 (32.8%)	434 (27.0%)	
Orange	121 (21.3%)	539 (33.5%)	
Red	76 (13.8%)	429 (26.7%)	
Total	552	1,608	

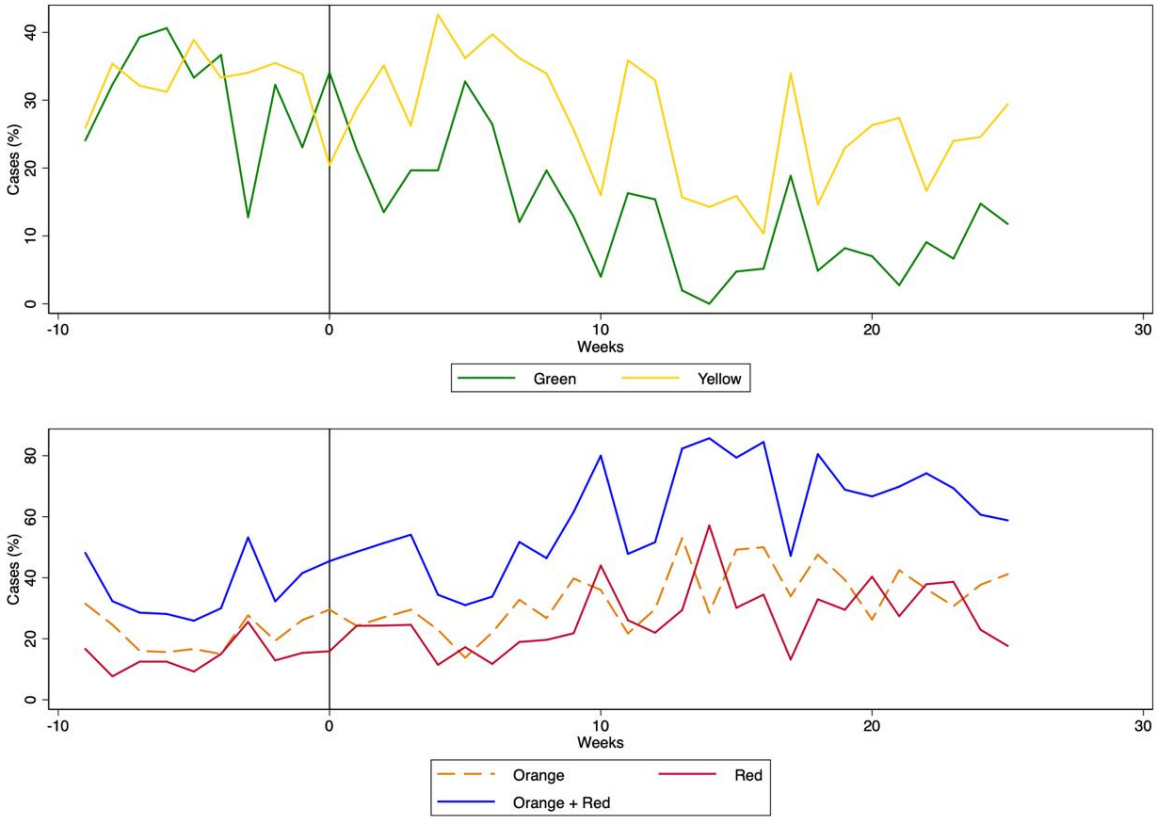


Figure 4.4 Proportion of expected triage codes before and after the implementation of the SATS (black line).

Table 4.4 shows results regarding the accuracy of SATS triage performed by local nurses during the post-implementation phase. The overall rate of triage accuracy, under and over-triage were 34.2%, 36.3% and 29.5% respectively. Figure 4.5 reports the association between time and triage accuracy, displaying an increasing trend in triage accuracy from December 2019 (29.4%) to May 2020 (42.0%). This result was confirmed in the logistic regression, showing a statistically significant association between time since implementation and accuracy of triage

(p value < 0.05). On the other hand, gender and age of patients did not influence the accuracy of triage.

Table 4.4 Comparison between the triage code originally assigned by local personnel and the code retrospectively obtained by researchers (in **bold** the number of correct triages performed by local personnel).

		Expected				Undertriage	Overtriage	Total
		Green	Yellow	Orange	Red			
Assigned	Green	**29 (23.0%)**	67	25	5	97 (77.0%)	-	126
	Yellow	62	**142 (31.3%)**	173	79	252 (55.3%)	62 (13.6%)	456
	Orange	94	181	**268 (34.5%)**	235	235 (30.2%)	275 (35.4%)	778
	Red	21	44	73	**110 (44.4%)**	-	138 (55.7%)	248
	Total	206	434	539	429	584 (36.3%)	475 (29.5%)	1,608

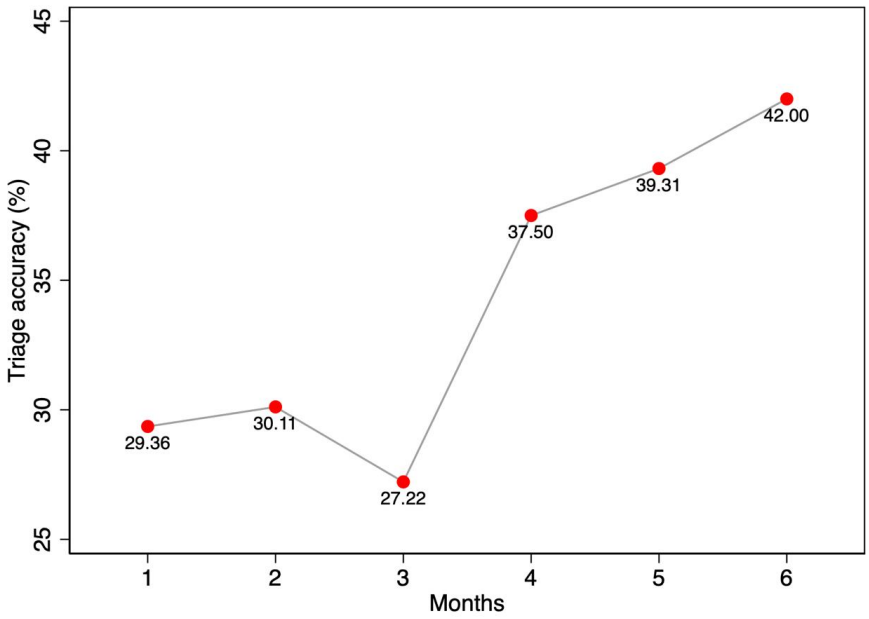


Figure 4.5 Triage accuracy (proportion of assigned codes matching with expected codes) across the time in the post-implementation phase.

4.4 Discussion

The integration of SATS in the urban ambulance system of Beira modified the pattern of transported patients, improving the selection process and enabling local staff to get acquainted with the notions of triage and referral protocols, concepts that are still uncommon in Mozambique [88].

The increase in the proportion of severe cases transported from the HCs to the CHB followed a continuous, progressive trend, suggesting that the concept of patient prioritization and the related protocol might need time to be fully mastered by local professionals. Gradually, the "first-in-first-out" approach that aimed purely to reduce the pressure on the constantly overcrowded HCs, was replaced by a more coordinated system that had the utmost goal of addressing the limited resources available in post-cyclone Mozambique to the most severe cases, optimizing the use of the few ambulances, health care staff, and hospital assets available [12]. Transport rates were similar before and after the implementation of the SATS, suggesting that the service worked from the beginning at his maximum capacity and highlighting the importance of regulating the referral process through a standardized and rational approach.
To the best of my knowledge, this is the first formal assessment of the integration of SATS in the referral protocol of a low-income country. The decision to introduce the SATS to improve the existing referral service stemmed from its proven suitability for low-resources context, evidenced by its algorithm-based approach, the availability of ready-to-use charts and training manuals, and the inclusion of easy-to-record vital signs [83, 91, 92].

Nevertheless, it should be also noted that the use of SATS in this prehospital setting was associated with high rates of mis-triage compared to the thresholds of 15% and 10% for over- and under-triage that are usually deemed acceptable in hospital settings [89]. The *BeTS Study* results are consistent with those of Mould-Millman and colleagues [89], reporting high rates of under-triage among prehospital providers asked to assess clinical vignettes and assign a final SATS triage colour. The authors suggest that the degree of miscalculation of TEWS, identified as one of the most frequent cause of error in assigning the final triage colour, could be further exacerbated under stressful real-life circumstances, such as the management of acute patients. Incorrect identification of predetermined emergency conditions and incorrect selection of clinical discriminators are other common errors reported in the literature [89, 93]. Since our analysis focused exclusively on under- and over-triage rates without investigating the root causes behind the mistakes made by nurses, future studies are warranted to address this specific aspect and better assess any intrinsic limitation in the application of SATS in the prehospital setting.

On the other hand, it should be also noted that the main aim of the referral protocol implemented in the urban ambulance system of Beira was to avoid the transportation of green codes to the CHB. Under this aspect, the misclassification between yellow, orange, and red codes did not affect the referral indication. It is also noteworthy that among the 126 green code patients erroneously referred to the CHB, the vast majority have been under-triaged (Table 4.4). This could mean that nurses could have recognized the mismatch between the assigned green code and the actual clinical condition, subsequently deciding to refer the patients to CHB anyway, a frequent phenomenon already described in literature [87, 89, 93]. Despite this procedure is contemplated in the SATS [94], it could have led to an apparent mis-triage due to the contrast between recorded clinical parameters and triage codes assigned retrospectively.

The question whether SATS represents the best available option to regulate acute patients' referral in the prehospital setting is still under debate. Further clinical studies are needed to better understand its use in this context and whether any adaptation is required to adjust the algorithm according to prehospital needs.

The findings of the *BeTS Study* should be interpreted considering some limitations. First, the assessment was performed immediately after the implementation of SATS protocol, thus intercepting the learning curve period of local nurses and not investigating the long-term effects of the SATS introduction. In addition, data used for this study were gathered from patients' referral charts, thus only including information on patients referred to the CHB. Therefore, the information about the actual number of patients assessed and treated at each HC in the selected timeframe was not available, and it was not possible to estimate the proportion of the different codes assigned to patients who not referred to the CHB. Finally, as available data do not include information related to patients' in-hospital outcomes, it was not possible to establish whether the prioritization of severe cases in the referral system effectively translated into improved health outcomes.

4.5 Conclusions

The integration of SATS in the Beira urban ambulance referral system has the potential to regulate the transport of acute patients to the central referral hospital, thus increasing the number of severe cases receiving advanced medical care. Despite nurses' performance ameliorated with the routinary application of the protocol, the use of SATS in this setting was associated with high rates of mis-triage, suggesting a possible scope for improvement. An analogous approach can be replicated in other similar contexts to further investigate factors that might impact SATS triage accuracy in prehospital settings.

Chapter 5

Applied works - COVID-19 surge capacity solutions

Part of this chapter is based on:

Daniela Sacchetto, Mario Raviolo, Cristiano Beltrando, and Nicola Tommasoni. COVID-19 surge capacity solutions: Our experience of converting a concert hall into a temporary hospital for mild and moderate COVID-19 patients. *Disaster Medicine and Public Health Preparedness*, pages 1–4, October 2020. doi:10.1017/dmp.2020.41.

AUTHOR CONTRIBUTIONS: Conceptualization, D.S., M.R, C.B. and N.T.; methodology, D.S.; validation, D.S.; formal analysis, D.S.; investigation, D.S.; resources, D.S.; data curation, D.S.; writing-original draft preparation, D.S.; writing-review and editing, M.R., C.B. and N.T.; visualization, D.S.; supervision, M.R.; project administration, D.S. and M.R.

5.1 Converting a concert hall into a temporary hospital

5.1.1 Introduction

The COVID-19 began in China in early December 2019 and rapidly spread to many countries around the globe: the WHO defined the emergency as a pandemic at the beginning of March 2020 [95].
In Italy, the emergency started on February 20th 2020, when the first case of COVID-19 was registered in Codogno, Lodi Province, Lombardia, Northern Italy. In the following days, the

disease cases were found in other Regions of Northern Italy including Piemonte. Starting at the end of February 2020, the number of patients affected with COVID-19 registered in Piemonte began to increase exponentially, stressing the Regional Health System with hospitals challenging to cope with the surge of patients affected by COVID-19: the hospitals implemented their surge capacity modifying the configuration of their wards and Intensive Care Units (ICUs), to increase the number of available beds for COVID-19 positive patients. In particular, the number of ICU beds available in Piemonte was increased from 287 to 554; the number of "sub-intensive" beds from 90 to 270 [96, 97].
Under these circumstances, on March 27th 2020, the Piemonte Government evaluated the idea of building a rapid-assembly emergency hospital for the treatment of mild and moderate COVID-19 patients. Although the request of hospital beds for COVID-19 patients was slightly decreasing at the end of March, this decision was prompted not only by the urgent needs, but also by a forward-looking approach: during the months immediately after the emergency, it will be important to have a place in which it will be possible to admit COVID-19 patients, allowing the conventional hospitals to clean and set up the wards for common inpatients.
The final temporary hospital consisted of a total of 90 beds, organized as four ICU beds, 30 sub-intensive beds and 56 ward beds. The set-up works started on April 4th 2020, and the first patient was admitted on April 19th 2020.
The aim of this section is to document the conception and building of a temporary hospital during the COVID-19 pandemic in Northern Italy, reporting the project from the first idea, as recommendations and information for other countries and professionals who are fighting the emergency worldwide.

5.1.2 Narrative

Site and idea

The place identified to set up the temporary hospital was the concert hall at Officine Grandi Riparazioni (OGR), in Turin, which will be referred to as *OGR Temporary Hospital* in the following. The site presented numerous logistics advantages, such as the availability of about 6,000 sqm, covered and heated, the availability of a high power electricity system (due to normal use for concerts), and the availability of a parking space for personnel. Moreover, a fundamental strong point that the site demonstrated was the presence of two separated air treatment units that allowed a light negative pressure area where identified COVID-19 patients will be admitted (red-zone).
The conversion of the site from a public show place to a COVID-19 temporary hospital required

the development of oxygen and electricity systems, the building of temporary walls, and the installation of toilets and showers (pre-assembled containers) to increase the number of bathrooms available for patients and workers.
Following a criterion of territorial relevance, the Piemonte Government decided to set up this temporary hospital as a virtual extension of the Azienda Sanitaria Locale Città di Torino (ASLTO) that, since the building phase was finished, manages all the running operations as an additional and displaced ward of one of its conventional hospitals.
The target of this temporary hospital was to accommodate mild and moderate COVID-19 patients: if their conditions become more severe, they will be transferred to a higher-level traditional hospital for further treatment. The ICU beds were designed and implemented only to stabilize patients while waiting for referral to the identified conventional hospital.

Layout and equipment

Figure 5.1 shows the site, divided into the three main areas:

1. the red-zone, a contaminated area in which patients are admitted and personnel can enter only wearing adequate Personal Protective Equipment (PPEs);

2. the yellow-zone, a semi-clean area where the health workers put on the PPEs;

3. the green-zone, a clean area in which personnel can work as usual, without PPEs and in which there is a clean warehouse for expensive material that it is safer to not keep in the red-zone, such as drugs or backup devices.

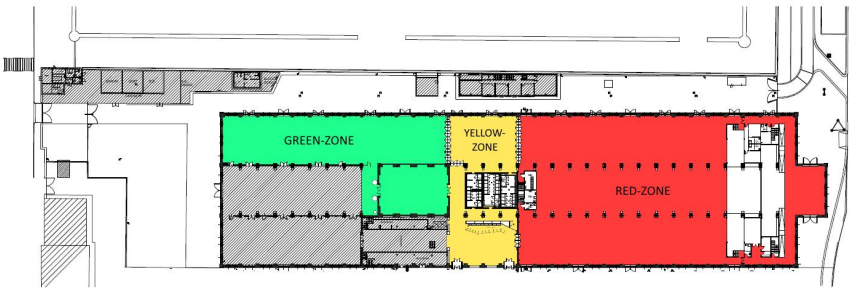


Figure 5.1 The OGR Temporary Hospital was divided into three areas: a) red-zone, a contaminated area with COVID-19 patients, b) yellow-zone, an intermediate area between clean and contaminated ones and c) green-zone, a clean area for managing activities not related to patients. Shaded areas stand for sectors not available for the hospital.

Figure 5.2 details the red-zone. The 90 beds were organized in 12 boxes and one shelter, separated by two main aisles; the boxes, containing two, six or eight beds each, were designed to assure different levels of care (the smaller ones are for ICU beds) and reasonable privacy for patients, in addition to being a valid support to build the electrical and oxygen systems. In particular, the separating walls of boxes were designed 1.5 meters tall: the idea was to assure both privacy and reduction of personnel needed to take care patients. In fact, separated rooms as in a conventional hospital, force a higher health-care workers-patients ratio because health-care providers are unable to see inside the other rooms compared to a "semi-open" space.

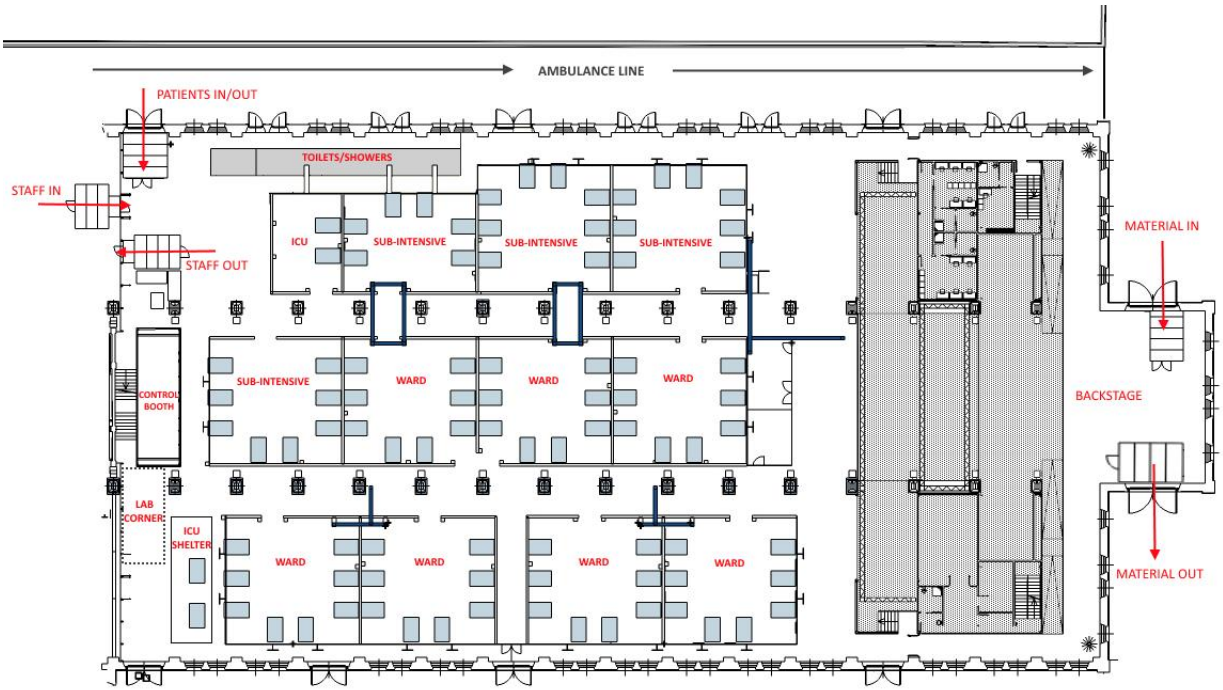


Figure 5.2 Red-zone layout of the OGR Temporary Hospital.

Two specific areas of the concert hall were used taking advantage of their position and their characteristics: the backstage and the control booth.
The backstage was designed to accommodate an area for the unload and the re-supply of materials that can be stored in the red-zone, and an exit line for the dirty materials (linens and clothes, waste, bodies, etc.). These routes were easily accessible from a main road and were separate from both the ambulance line and patients entrance and discharge.
The control booth was set up as the direction and coordination room: this space was on an upper level compared to the patients' area, allowing the medical director and the nurse coordinator to have a global overlook on the red-zone (see Figure 5.3).

Figure 5.3 Overview from the direction/coordination room (control booth of the concert hall).

All the ways to enter in and to exit from the red-zone for personnel, patients and materials were protected by passages; each of these passages was designed as a small room closed with a ceiling, provided with one window to see inside before entering and with a swing door in the side closest to the red-zone.

The number of available toilets and showers in the red-zone was 18 and 8, respectively, increasing the building's normal availability with four shelters located along the first line of boxes. Two additional sinks, dedicated to health workers necessities, were installed at the two extremities of the first aisle.

Regarding the oxygen supply system, the decision taken for the OGR Temporary Hospital was to use Oxygen 93 manufactured on-site, using an oxygen Pressure Swing Adsorption (PSA) concentrator unit able to produce 60 m^3/hour of gas. PSA concentrators are normally used in field hospitals by military forces and are listed as a solution in the WHO Interim Guidance regarding the oxygen sources and strategies for COVID-19 treatment [98].

Concerning the electrical supply system, all the 90 patients' spaces were equipped in the same way, to assure flexibility and transformability in case of further needs. In particular, in addition to the oxygen supply point, each bed was equipped with six electrical universal plugs, one lamp, one service plug and one patient alarm. A backup generator of about 600 kW power was

located outside the building to be used in case of failure of the primary electrical supply.
From a safety point of view, the installation of one ceiling video camera for each box and for the aisle along the toilets shelters allows the supervision of the patients' situation from the direction/coordination room.
Finally, the entire red-zone was wired to allow a Local Area Network (LAN) connection for the ICU and sub-intensive beds, whereas a wifi-network was established to allow the use of electronic clinical patient records inside the OGR Temporary Hospital.
A complete list of the medical devices provided (purchased, donated or retrieved from conventional hospitals' unused equipment) for the OGR Temporary Hospital is reported in Table 5.1. Regarding the medical devices, "sub-intensive" beds were equipped, as usual, with a monitor, Continuous Positive Airway Pressure (CPAP) system, suctioning system and syringe pumps rack, while the ICU beds included a ventilator in addition to all the previously listed equipment. Among others, two defibrillators, four ultrasound machines, two electrocardiographs, two scialytic lamps and two refrigerators for drugs were positioned along the two main aisles. In a dedicated corner, some laboratory machines for routine blood tests and one x-ray mobile unit for chest exams were allocated to be easily used in case of need.

Table 5.1 OGR Temporary Hospital medical devices.

Medical devices list	
n. 86 electric hospital beds	*Laboratory machines:*
n. 4 electric ICU beds	n. 4 arterial blood gas (ABG) analyzers
n. 4 ventilators	n. 1 blood count analyzer
n. 50 helmets CPAP	n. 1 blood chemistry analyzer
n. 40 monitors	n. 1 blood coagulation time analyzer
n. 100 syringe pumps	n. 2 glucometers
n. 20 suction systems	n. 1 cardiac marker analyzers
n. 4 video laryngoscopes	n. 1 urine analyser
n. 4 ultrasound devices	
n. 2 defibrillators	
n. 2 elettrocardiographs	
n. 60 pulse oximeters	
n. 60 pulse oximeters	
n. 1 mobile digital x-ray unit	
n. 2 refrigerators for drugs	
n. 2 scialytic lamps	

Staff

The ASLTO team served as the leading clinical team, recruiting anesthesiologists, emergency doctors, nurses and other healthcare professionals, such as laboratory and x-ray technicians, to work in the OGR Temporary Hospital.

In addition to that personnel, a team of 37 healthcare professionals came from Cuba [99] to help Piemonte face the COVID-19 pandemic. All the foreign personnel underwent a specific training about the application and removal of PPEs, the use of the electronic medical records software and the standard operating procedures and clinical protocols commonly used in the ASLTO conventional hospitals. Once the training was completed, the foreign personnel started to work side by side with the Italian staff.
The OGR Temporary Hospital requires fewer doctors and nurses than conventional hospitals for two main reasons: first, the "semi-open" space layout assures more visibility and reduces the number of health workers needed per room, and second, all the patients admitted have only mild to moderate COVID-19 disease.

5.2 Converting a public parking into an urban field hospital

5.2.1 Introduction

This section documents the case study of an urban field hospital opened in Turin, Piemonte (Northern Italy)´s main city, at the beginning of Italian´s COVID-19 second wave in November 2020 as a strategy to unburden the hospital system. To date, Italy has been one of the most affected countries by the pandemic and among Italian regions, Piemonte has had one of the highest numbers of COVID-19 infections and deaths. Public health departments, EMS, and hospitals have experienced an unprecedented over-burdening and have been struggling to deal with the surge of patients affected by COVID-19 and sought to find alternative ways to allocate in-patients.
Local public health authorities implemented several strategies in order to cope with the increased pressure over the system:

1. dispensable services (i.e., elective surgery) were temporarily closed;
2. community-based services, aimed at ensuring the care for COVID-19 patients, were strengthened, as a means to filter the unnecessary hospitalizations;
3. sporting, cultural spaces and schools were converted into temporary hospitals or "de novo" field hospitals (as already described in the previous Section 5.1).

At the beginning of November 2020, the Piemonte Government decided to build a field hospital for the treatment of mild COVID-19 patients to cope with the second wave of the pandemic: in particular, in those days, the statistical predictions depicted a scenario of exponential growth of

COVID-19 cases, with doubling period of almost 7 (6.9) days, in the order of size of 20.000 new COVID-19 cases and of 3500 additional ward beds in the following week [100]. The regional government appointed the Disaster Medicine Service 118 team to supervise the technical parts of this new rapid-assembly emergency field hospital. This team has proved to be expert in supervising the creation of similar hospitals, both during international missions (see Chapter 2) and during the first wave of the COVID-19 pandemic (see Section 5.1).
Drawing from that experience, this section proposes a model of an intermediate/low-care urban field hospital to be used during pandemics, disasters and emergencies to unburden the hospital system by providing care for an interim period to patients with a low level of medical complexity recovering from severe diseases, who are not ready for or able to be discharged home.

5.2.2 Narrative

Site and idea

The site identified to set up the urban field hospital was a great underground parking of about 8,000 sqm in the city of Turin. This size allowed for the placement of up to 500 hospital beds. This parking was in the middle of “Parco del Valentino”, a green park in the center of the city, just 6 minutes by car from the ER of the Azienda Ospedaliera Universitaria Città della Salute e della Scienza di Torino, also know as "Molinette" Hospital (MH), the largest tertiary referral hospital in Turin and in the Piemonte region. From the position of the field hospital derives the name *Valentino Field Hospital* used in the following.
Although the site had some advantages (protected from the elements, easily accessible, close to a third-level referral university hospital), it also posed several challenges. The parking lacked a connection to adequate water, electricity, sewage, and heating/air treatment systems. Moreover the building phase had to be as quickly as possible to face the exponential growth of patients positive to the virus.
The choice to deploy a field hospital made up with tents, differently from what done previously in the same region (see Section 5.1), was prompted by several reasons: firstly the race against time, immediately followed by the need to assure protection and privacy to patients giving them something similar to rooms with single or multiple queued tents. In addition to these reasons, tents represented a valid logistic support to build the electrical and oxygen systems.
After the decision and a first week of planning and design, the set-up works started on November 11st 2020, and the first patient was admitted on November 22nd 2020 [101]. The field hospital finally deployed consisted of a total of 455 beds, including 2 ICU beds and 6 sub-intensive beds

to use as emergency stabilization for patients suddenly evolved to critical before their referral to the closest hospital, in addition to the other 447 ward beds for mild COVID-19 patients.

Layout and equipment

As shown in Figure 5.4, all the parking area was converted into a huge red-zone, in which patients were admitted and personnel had to wear adequate PPEs; 3 of 4 tunnels, originally dedicated to the evacuation of people in case of fire, were large and high enough to maintain their main role and to become green zones, in which two dressing rooms (one for men and one for women) used by personnel to put on uniforms before starting their work shift, and a warehouse to stock material, were set up. As done previously (see Section 5.1), all the ways to enter in and to exit from the red-zone for personnel, patients and clean materials were protected by passages to ensure the adequate separation between contaminated and not-contaminated area: in particular, the passages dedicated to the personnel were built large enough to facilitate the health workers to put on and take off the PPEs before entering and exiting from the red-zone. The remaining tunnel was the dirty line reserved to exit material (linen and clothes to be sanitized, waste, bodies, etc).
The canteen, the administrative offices, the relax area, the toilets and the showers for personnel were located outside the background parking, in the surrounding area.
Regarding the layout of the red-zone, three different types of "tents" were deployed basing on the immediate availability of the structures:

a) n. 38 steel-frame tents (blue ones in Figure 5.4);

b) n. 11 inflatable tents (yellow ones in Figure 5.4) and

c) n. 6 temporary disaster shelters (grey ones in Figure 5.4).

Different types of tents mean different sizes and capability: 3, 6, 8, 12, 25 beds were set up in each tent and rooms were realized connecting tents to one another (pairing the front doors) in a modular fashion, to save personnel and space. Besides the tents, 18 shelters (Regional Civil Protection pre-assembled containers) were installed along the perimetral walls of the parking to have 80 toilets and 32 showers dedicated to patients. This positioning was bound by the availability of the black water discharge and water supply. The standards established for disaster response [102–104] state that 1 toilet/shower to 20 inpatients/people should be respected; however, as this temporary hospital was located in a western-high income country, and as the aim was to assure a hospital-like treatment to patients, following what previously done in the

OGR Temporary Hospital (see Section 5.1), the ratios of toilet-patients and shower-patients of less than 1:6 and 1:15, respectively, were considered appropriate for the Valentino Field Hospital. Eight foldaway sinks, dedicated to health workers necessities, were located in the red-zone too.

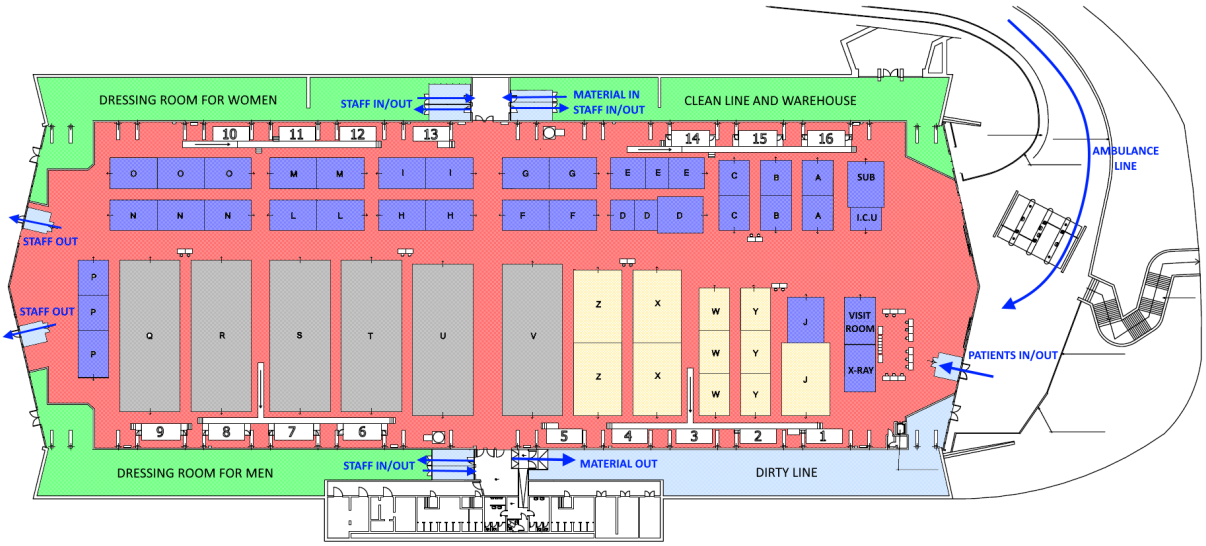


Figure 5.4 Layout of the Valentino Field Hospital. The areas dedicated to the personnel, such as the administrative desks, the canteen and the kitchen, the toilets and showers are not displayed in the figure since they are located outside of the underground parking.

Besides the heating, air treatment and electrical system that were built to convert a public parking in a temporary hospital, a noteworthy issue was the oxygen supply system that allowed oxygen for nearly 80% of the available beds (362/455), that could be all supplied with 5 lt/min at the same time. The 8 beds dedicated to critical patients (n.2 ICU plus n.6 sub-intensive) could be supplied with high flow too. As good practice in the conventional hospitals, the supply system was realized with three sources of supply (i.e. 14.000 l as primary source, 10.000 l as secondary source and three rack for a total of 48 cylinders of 50 l each as reserve source) to ensure that gas would be available in the event of a single fault condition, and with a distribution network to bring the oxygen to the beds.

Regarding the furniture, cots were used instead of hospital beds, except for ICU and sub-intensive. A chair for each bed was dedicated to belongings of inpatients such as the pockets on the internal walls of the tents when present. A list of furniture, medical devices and supplies is reported in Table 5.2.

Eighty video cameras were installed to look at each tent, aisle and hidden ways or corners, to assure security to patients.

Finally, a wifi and a wire connection networks were installed to allow the use of electronic clinical patient records inside the Valentino Field Hospital and to give patients the opportunity to use personal mobile phones and/or internet-accessible devices to stay in contact with their relatives.
Figure 5.5 shows an overview of the hospital and of the inside of its "rooms".

Table 5.2 Valentino Field Hospital furniture and supplies.

Furniture and supplies list
n. 8 electric ICU beds n. 447 Folding cots with mattress n. 6 vital sign monitors n. 4 transportable ventilators n. 4 elettrocardiograph machines n. 8 monitor-defibrillators n. 4 automated external defibrillators (AED) n. 12 portable suction systems n. 112 infusions pumps n. 12 portable ultrasound devices n. 4 video laryngoscopes n. 1 mobile digital x-ray unit n. 4 refrigerators for drugs and pharmaceuticals n. 455 oxygen flowmeters n. 2 weighing scales n. 14 stretchers n. 20 trolleys for anesthesia, ward round, emergency n. 80 video cameras n.1 television (for patients entertainment)
Information technologies equipment (laptops, computers, printers, telephones, wifi routers, etc) *
Furnishings (tables, chairs, shelves, foldaway sinks, etc)*
Drugs and consumables *

*Adequate quantity basing on the material availability and needs

Staff

The suggested model of care at the Valentino Field Hospital was a low-intensity “step-down” field hospital. Patients admitted to the facility had to be self-sufficient (or only in need of minimal assistance to walk) and mildly or moderately symptomatic, required low oxygen therapy (if any) and took only orally administered medications (along with intramuscular antibiotic injections in a small number of cases). Given the low-intensity care need of these patients, the health care staff to be implemented in this case was mostly constituted by nurses with support from healthcare assistants.

Figure 5.5 (a) Overview of the Valentino Field Hospital. (b)(c) Inside of the "rooms" built up with different types of tents.

The medical staff assumes the role of "ad hoc" supervision in cases where the nurse deems it necessary, for example in cases of clinical deterioration or urgency that require stabilization, pharmacological treatment and the possible referral to hospital facilities of second or third level.

The MH supplied the staff for the Valentino Field Hospital. However, many of the assigned staff had limited or no experience in emergency and disaster medicine or in working in such a new unconventional context. Furthermore, the MH also sent many of its resident physicians and nursing students to work in the new facility so that they could gain experience outside of their areas of specialization. All health care professionals received a three-day intensive training including a course about general principles of disaster medicine, Infectious Prevention and Control (IPC) standard precautions, use of PPEs, staff behavior in outbreak setting, COVID-19 clinical information and use of the equipment (oxygen supply system, monitoring, saturation)

and an exercise consisting in a simulation scenario inside the Valentino Field Hospital (set up before the admission of the first patient).

5.3 Discussion

As the recent literature [105–111] and news around the world [112–114] show, the idea to convert a public place into a temporary hospital has been widely used during the COVID-19 emergency, especially in China, with the opening of 16 "Ark/Fangcang" shelter hospitals in Wuhan, treating more than 12,000 patients in stadiums and exhibition centres. In fact, temporary and field hospitals can give an immediate response to the request of new beds from stressed hospitals, with time and cost reduction compared to the building of new conventional hospitals or conventional wards. However, the solutions implemented with OGR Temporary Hospital and Valentino Field Hospital brings along some important considerations.

First of all, the Piemonte idea was different both from what was done in China with shelter hospitals and from what was done in Lombardia [114]: the point of strength of the OGR Temporary Hospital was to have a potentially replicable model both to cope with the immediate need of beds by stressed hospitals, and to admit future COVID-19 patients while conventional hospitals restore to the pre-pandemic configuration. Moreover, building hospitals targeted for only mild and moderate patients, as done both for OGR and Valentino solutions, allowed not only to contain costs regarding equipment and staff, but also to avoid the risk of the temporary hospital being ready, since the building phase lasted at least 10-15 days from the decision to build it, when the peak of severe and critical patients was already decreasing, but the need of lower level beds was still ongoing.

Second, the "semi-open" space layout, implemented in the OGR Temporary Hospital, together with the type of patients admitted, allowed for a reduction of the amount of personnel involved, which is a considerable problem in the case of such a contagious disease, stressing the health system both for the effort required by health workers and for the number of health workers getting sick every day.

Then, to avoid what is reported by Yuan et al [107] about patients feeling worried and marginalized by the admission into not-conventional hospitals, both the hospitals were built assuring high-standard clinical devices, high-technology, nice furniture and attention to structural details. These important elements helped the patients feel as though they were being treated the same way as patients in a conventional hospital. Regarding the Valentino Field Hospital, in which the effect reported by literature could be intensified by the tents and the shelters where

patients were admitted instead of conventional rooms, the large screen tv installed and the wifi connection covering all the area aimed to improve the impression regarding the type of "accomodation".

Finally, healthcare is a sector that is characterized by relationships with multiple stakeholders, overlapping goals of activity, complicated decision-making systems and autonomy of facilities [115]. This is especially true in case of emergencies, when the request is to build up temporary hospitals for hundreds of patients in a really short time (specifically, 16 days for OGR Temporary Hospital, 11 days for Valentino Field Hospital). Thus, it is evident that the project management and the coordination are essential. In particular, the involved actors in this type of projects are multiple: logistics people following the heating, electrical and water system to adapt a different site into a hospital; people in charge for the purchase of material, medical devices, drugs and consumables; the Authorities, such as policemen or firefighters, involved to evaluate the change intended use of the site; the staff working in a new, different type of hospital, needing training during the preparation stage. A clear timeline, a defined chain of command and roles' organigram and a teamwork attitude are the essential pills of the success of this kind of challenges; after all, as reported by Kocak et al [116], the disaster medicine incorporates many characteristics of management science such as command, coordination, planning, exercise, strategy, administration voluntary management, and economic sustainability.

5.4 Conclusions

This chapter described two challenging experiences faced during the COVID-19 pandemic to cope the surge of patients: it is aimed at health care professionals engaged in disaster contexts and proposes a model that can be scaled up in similar settings, when demand exceeds hospital capacities. In addition, the experience gained during the development of these kind of emergency hospitals will allow for better preparation of further such units and more optimal use of medical personnel and equipment.

Chapter 6

Conclusions and future research

The research reported in this thesis wanted to better analyze operational resources in humanitarian setting during the disaster and recovery phases after the Cyclone Idai, that hit the Mozambique in March 2019.

In particular, data collected during the EMT2-ITA mission in Mozambique showed, once again, how the role of an EMT depends from the arrival timing and the conditions of the local health facilities after the disaster: the EMT2-ITA, becoming operative several days after the Cyclone Idai, was predominantly involved in elective activities, to support and maintain the ordinary healthcare capacity of the affected country. A successful integration with local staff assured not only to limit the number of foreign workers during the rotation of personnel, but also the training about the use and maintenance of the equipment, entirely donated to the host country at the end of the mission.
Moreover, teamwork and non-technical skills in general are essential issues to perform effectively in the field during disasters. The *Team dynamics study* conducted during the disaster phase showed that humanitarian workers, working together for the first time without a prior specific training, feel good but not at their best. The introduction of training programs focused on team dynamics seems to be a solution for this.
Next, the *Resilience study* revealed a good resilience, both organizational and personal, and a good perceived organizational support for the team deployed in Mozambique, with a strong association between the organizational resilience and the perceived organizational support.
Moving to the recovery phase, the *BeTS Study*, integrating SATS in the Beira referral system, showed improvement in the transport of patients from the peripheral centres to the central referral hospital, thus increasing the number of urgent cases receiving advanced medical care.

Doubtless, my direct involvement in a humanitarian mission gave me the opportunity to collect the data and design the study protocols following a privileged route, a "shortcut" compared to whom tries to do disaster research "from home".
Nevertheless, the direct experience offered only one source of data and generalization is often difficult. Further studies are needed.
Future research including field reports from other humanitarian missions would be really important for many reasons. First, in case of deploy of the Italian field hospital in contexts similar to Mozambique 2019, it would be interesting to see the application of lessons learnt after the first mission; then, analyzing other missions would be really useful to compare outcomes, investigating differences and similarities in medical and operational activities during different types of disasters. Lastly, the extension of research to other classified EMTs, offering different levels of services, could provide evidences to support the importance of EMT Initiative.
Then, as further perspective, the survey studies should be extended to other EMTs to enlarge the sample size and confirm (or not) the findings with stronger results. In addition, new studies should investigate the availability of performance indicators free from the individual perception of the own ability. Even the *BETs Study* should be replicated in other similar contexts to further investigate factors that might impact SATS triage accuracy in prehospital settings.

Finally, the application of EMT experience and standards during the COVID-19 pandemic in my home country, brought along important considerations to share with the disaster research community. The two applied works presented at the end of this thesis described the development of a temporary and an urban field hospital in the center of Turin (Piemonte, Northern Italy), mainly from a logistic and operational point of view. Future works regarding the type of patients admitted and the "field" activities would be essential to better understand the role of EMT, also in case of highly infectious diseases in high-income countries.

Executive Summary

Natural disasters cause, approximately, the death of 60,000 people per year, leaving behind destruction and devastation in the affected countries. Each disaster raises many questions about how best to respond, but evidence is often lacking or incomplete to answer such questions. Conducting research during or in the aftermath of disasters is crucial to accurately describe and report phenomena, response type, experiences, lessons learnt and to support and guide decision-makers.

Motivating by my direct experience in the humanitarian settings during the response to a disaster event in Mozambique in 2019, the Cyclone Idai, this thesis presents the research activities conducted during both the disaster and the recovery phases.

The research is focused on the analysis of the mission from a descriptive point of view, reporting the impact of mobilizing timing on the mission outcomes, describing the clinical activities and the organization of the field hospital and of the staff.

Team dynamics and non-technical skills are assessed with a survey study conducted during the disaster phase among the team deployed in Mozambique: humanitarian workers, obliged to work together for the first time without a prior specific training, feel good but not at their best. Specific training programs can be really useful to improve their self-confidence before a mission.

In addition, a survey study examined the team members perception from a mental health perspective, showing a good resilience, a good perceived organizational support and a strong association between these issues for the team deployed in Mozambique in 2019.

Moving to the recovery phase after the Cyclone Idai, a triage method has been introduced in the referral process of the patients from peripheral centers to central ones. Collecting data about the proportion of referred codes and about the triage accuracy, this original research study shows that the use of the method improve the prehospital selection process, modifying the pattern of the referred patients.

Lastly, two operational works regarding my involvement during the Coronavirus Disease 2019 (COVID-19) pandemic, are presented in the final part of the thesis.

Samenvatting

Natuurrampen veroorzaken jaarlijks ongeveer de dood van 60.000 mensen met daarnaast ook de vernietiging en verwoesting van huisvesting en natuur in de getroffen landen. Elke ramp roept steeds veel vragen op hoe men het best zou optreden in de hulpverlening, maar vaak ontbreekt hiervoor antwoord door het gebrek aan "evidence-based" bewijsmateriaal. Het uitvoeren van wetenschappelijk onderzoek tijdens of in de nasleep van rampen is daarom cruciaal om nauwkeurig de mechanismen van ontstaan van een ramp te kunnen beschrijven maar ook de wijze van hulpverlening, de opgedane ervaringen door de hulpverleners, de "lessons-learned" door de hulpverleners beter te begrijpen teneinde beter voorbereid te zijn bij toekomstige calamiteiten. Dit proefschrift beschrijft de directe ervaring tijdens zowel de ramp-als de herstelfase van een humanitaire hulpverleningsmissie voor de cycloon Idai in Mozambique in 2019.
Het onderzoek is gericht op de analyse van de missie vanuit beschrijvend oogpunt, waarbij de impact van de timing van mobilisatie van het rescue-team op de missieresultaten wordt weergegeven, alsook de beschrijving van de klinische activiteiten en de organisatie van het veldhospitaal en van het personeel. Teamdynamiek en niet-technische vaardigheden worden beoordeeld via een enquête afgenomen tijdens de ramp bij het team dat in Mozambique wordt ingezet: humanitaire hulpverleners die voor het eerst samenwerken zonder voorafgaande specifieke training. Daarnaast werd ook via een enquête gepeild naar de perceptie van teamleden op geestelijke gezondheid, vertonen van een gezonde veerkracht, alsook de perceptie van een goede organisatorische ondersteuning. In de herstelfase na de cycloon Idai is een triage-methodologie geïntroduceerd in de verwijzingsproces van de patiënten van perifere hulpverleningscentracentra naar centrale centra. Op basis van datacollectie over de percentages van de doorverwezen patiënten alsook op basis van de registratie van de nauwkeurigheid van de triage, blijkt uit dit originele onderzoek dat het gebruik van de triage-methode duidelijk het preklinische "selectieproces" verbetert waarbij ook het patroon van de doorverwezen patiënten duidelijk werd gewijzigd. Tot slot worden ook twee operationele werkzaamheden met betrekking tot mijn betrokkenheid tijdens de Coronavirus Disease 2019 (COVID-19) pandemie worden in het laatste deel van het proefschrift weergegeven.

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Annex A

Team dynamics Study Survey

A.1 Team Self-Efficacy questionnaire

The questionnaire presented in the next page was handed out to all the participants twice:

1. before the deploy, during the journey to Mozambique, asking to participants to imagine what would be happened during the mission, and
2. after the deploy, during the flight back to Italy, asking to participants to remember what happened during the mission just ended.

Team Self-Efficacy Questionnaire

Dear participant,

Circle the relevant and complete the information:

Time of completion of this questionnaire: (1) BEFORE deployment / (2) AFTER Deployment

Gender: (1) Male / (2) Female / (3) Other or no response

Year of birth: _____

Role in team: _____

Please respond to these items assessing **your self-efficacy as a team** concerning your next deployment/past deployment. Rate each of the following statements by circling the appropriate number on a scale of 1 to 5 where 1 means you strongly disagree and 5 means you strongly agree, **trying to imagine what will happen during the mission/remember what happened during the concluded mission.**

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
1. Our team will be able to achieve most of the goals that we have set for the team	1	2	3	4	5
2. When facing difficult tasks, our team is certain that we will accomplish them	1	2	3	4	5
3. In general, our team thinks that we can obtain outcomes that are important to the team	1	2	3	4	5
4. Our team believes that we can succeed at most any endeavor to which we set our minds	1	2	3	4	5
5. Our team will be able to successfully overcome many challenges	1	2	3	4	5
6. Our team is confident that we can perform effectively on many different tasks	1	2	3	4	5
7. Compared to other teams, our team can do most tasks very well	1	2	3	4	5
8. Even when things are tough, our team can perform quite well	1	2	3	4	5

A.2 Team Emergency Assessment Measure (TEAM) questionnaire

The questionnaire presented in the next page was handed out to all the participants twice:

1. before the deploy, during the journey to Mozambique, asking to participants to imagine what would be happened during the mission, and
2. after the deploy, during the flight back to Italy, asking to participants to remember what happened during the mission just ended.

Circle the relevant and complete the information:
Time of completion of this questionnaire: (1) BEFORE deployment / (2) AFTER Training Gender: (1) Male / (2) Female / (3) Other or no response
Year of birth: _____
Role in team: _____

Team Emergency Assessment Measure (*TEAM*)

Introduction

This non- technical skills questionnaire has been designed as an observational rating score for valid, reliable and feasible ratings of emergency medical teams (e.g. resuscitation and trauma teams). The questionnaire should be completed by expert clinicians to enable accurate performance rating and feedback of leadership, team work, situation awareness and task management. Rating prompts are included where applicable. The following scale should be used for each rating:

Never/Hardly ever	seldom	About as often as not	Often	Always/Nearly always
0	1	2	3	4

Team Identification

Date: Time: Place:
Team Leader: Team:

Leadership: it is assumed that the leader is either designated, has emerged or is the most senior - if no leader emerges allocate a '0' to question 1 and 2.	**0 1 2 3 4**
1.The team leader let the team know what was expected of them through direction and command	☐ ☐ ☐ ☐ ☐
2. The team leader maintained a global perspective *Prompts: Monitoring clinical procedures and the environment? Remaining 'hands off' as applicable? Appropriate delegation.*	☐ ☐ ☐ ☐ ☐
Team Work: ratings should include the team as a whole i.e. the leader and the team as a collective (to a greater or lesser extent).	**0 1 2 3 4**
3. The team communicated effectively *Prompts: Verbal, non-verbal and written forms of communication?*	☐ ☐ ☐ ☐ ☐
4. The team worked together to complete the tasks in a timely manner	☐ ☐ ☐ ☐ ☐
5. The team acted with composure and control *Prompts: Applicable emotions? Conflict management issues?*	☐ ☐ ☐ ☐ ☐
6. The team morale was positive *Prompts: Appropriate support, confidence, spirit, optimism, determination?*	☐ ☐ ☐ ☐ ☐
7. The team adapted to changing situations *Prompts: Adaptation within the roles of their profession? Situation changes: Patient deterioration? Team changes?*	☐ ☐ ☐ ☐ ☐
8. The team monitored and reassessed the situation	☐ ☐ ☐ ☐ ☐
9. The team anticipated potential actions *Prompts: Preparation of defibrillator, drugs, airway equipment?*	☐ ☐ ☐ ☐ ☐
Task Management:	**0 1 2 3 4**
10. The team prioritised tasks	☐ ☐ ☐ ☐ ☐
11.The team followed approved standards and guidelines *Prompt: Some deviation may be appropriate?*	☐ ☐ ☐ ☐ ☐
Overall:	**1 2 3 4 5 6 7 8 9 10**
12. On a scale of 1-10 give your global rating of the team's non-technical performance	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Please write at least 3 things important for team working during missions:

_____

Comments: _____

Annex B

Resilience Study Survey

B.1 Demographic and professional experience questions

Questions (*Answers*)

1. Sex (*Female / Male*)
2. Age (*20-29 / 30-39 / 40-49 / 50-59 / 60 or older*)
3. Marital status (*married / widowed / divorced / single / unmarried couple*)
4. Period of working for this organization (*less than 1 year / 1-2 years / 3-4 years / 5-7 years / 8 or more*)
5. How many times were you deployed / sent to the field with this organization? (*never / 1-2 / 3-4 / 5-7 / 8 or more*)
6. When was the last time you were deployed / sent to the field with this organization? (*I was never sent to the field / less than one year ago / 1 to 2 years ago / 3 to 5 years ago / more than 5 years ago*)
7. In any of your positions within this organization, were you held responsible for expatriates or national staff? (*Yes / No*)
8. Have you been informed of psychosocial risks related to your activities (high levels of stress, burnout, long hours of work, etc.)? (*Yes / No / partially*)
9. Have you been informed of / trained on strategies to best deal with high levels of stress such as stress management? (*Yes / No*)
10. Have you ever been involved in a work accident while working for this organization? (*Yes / No*)
11. If you answer yes to question number 11, did you feel supported by the organization? (*Yes / No / partially / I didn't say "yes" to question 11*)

B.2 Perceived Organizational Support scale (POS)

Answers: Completely Agree / Partially Agree / Neutral / Partially Disagree / Completely Disagree.

English version	Italian version
1. The organization strongly considers my goals and values.	1. La mia organizzazione tiene in gran considerazione i miei obiettivi e i miei valori.
2. Help is available from the organization when I have a problem.	2. Se ho un problema, la mia organizzazione è pronta ad aiutarmi.
3. The organization really cares about my well-being.	3. La mia organizzazione si preoccupa davvero del mio benessere.
4. The organization would forgive an honest mistake on my part.	4. La mia organizzazione perdonerebbe un mio errore in buona fede.
5. The organization is willing to help me when I need a special favour.	5. La mia organizzazione è disposta ad aiutarmi se ho bisogno di un favore speciale.
6. If given the opportunity the organization would take advantage of me. (R)*	6. Se ve ne fosse l'opportunità, la mia organizzazione approfitterebbe di me. (R)*
7. The organization shows very little concern for me. (R)*	7. La mia organizzazione mostra molto poco interesse nei miei riguardi. (R)*
8. The organization cares about my opinions.	8. La mia organizzazione tiene alle mie opinioni.

*(R) indicates the item is reverse scored.

B.3 Short-form of Benchmark Resilience Tool (BRT-13)

Answers: Completely Agree / Partially Agree / Neutral / Partially Disagree / Completely Disagree.

Factor	English version	Italian version
Planning	1. We are mindful of how a crisis could affect us. 2. We believe emergency plans must be practised and tested to be effective. 3. We are able to shift rapidly from business-as-usual to respond to crises. 4. We build relationships with organisations we might have to work with in a crisis. 5. Our priorities for recovery would provide direction for staff in a crisis.	1. Siamo consapevoli di come un evento improvviso durante una missione potrebbe influenzarci. 2. Riteniamo che i piani di emergenza debbano essere praticati e testati per risultare efficaci. 3. Siamo in grado di muoverci rapidamente dalle attività abituali per rispondere ad un evento improvviso durante una missione. 4. Costruiamo relazioni con organizzazioni con cui potremmo dover lavorare in caso di un evento improvviso durante una missione. 5. Le nostre priorità di recupero guidano il personale in caso di un evento improvviso durante una missione.
Adaptive Capacity	6. There is a sense of teamwork and camaraderie in our organisation. 7. Our organisation maintains sufficient resources to absorb some unexpected change. 8. People in our organization "own" a problem until it is resolved. 9. Staff have the information and knowledge they need to respond to unexpected problems. 10. Managers in our organization lead by example. 11. Staff are rewarded for "thinking outside the box". 12. Our organization can make tough decisions quickly. 13. Managers actively listen for problems.	6. C'è spirito di squadra e cameratismo nella nostra organizzazione. 7. La nostra organizzazione dispone di sufficienti risorse per fronteggiare cambiamenti inaspettati. 8. Le persone nella nostra organizzazione "fanno proprio" un problema finchè non viene risolto. 9. Il personale dispone delle informazioni e delle conoscenze necessarie per rispondere a problemi inaspettati. 10. Le persone al comando della nostra organizzazione danno l'esempio. 11. Il personale viene premiato per "pensare fuori dagli schemi". 12. La nostra organizzazione può prendere rapidamente decisioni difficili. 13. Le persone al comando ascoltano attivamente i problemi.

B.4 Emergency Medical Services Resilience Scale (EMSRS)

Answers: Always / Often / Sometimes / Rarely / Never

English version	Italian version
1. I participate in missions without motivation.	1. Prendo parte alle missioni senza motivazioni.
2. I am biased towards my career.	2. Sono concentrato sulla mia carriera.
3. I stay in the organization because I have no other choice. (R)*	3. Rimango nell'organizzazione perchè non ho altra scelta. (R)*
4. I try to get the injured person quickly to a medical center.	4. Cerco di portare rapidamente la persona ferita in un centro medico.
5. I do my best all along the mission to survive the injured person.	5. Faccio del mio meglio nel corso di tutta la missione per mantenere in vita la persona ferita.
6. I trust in my judgments and decisions on the scene of the incident.	6. Mi fido dei miei giudizi e delle mie decisioni sulla scena del disastro.
7. I am responsible for what will happen to the injured person.	7. Sono responsabile per ciò che accadrà alla persona ferita.
8. I control the challenges in the scene of the incident.	8. Controllo le minacce sulla scena del disastro.
9. I can properly resolve the problems caused by missions.	9. Posso risolvere in modo appropriato i problemi che si presentano in missione.
10. At the scene of the incident, I want everyone to keep peace.	10. Sulla scena del disastro, voglio che tutti mantengano la calma.
11. In every situation, I will volunteer to save lives.	11. In ogni situazione, mi offrirò volontario per salvare vite.
12. In case of close proximity to the accident site, I am immediately notified to the unit of deployment.	12. In caso di stretta vicinanza al luogo del disastro, mi informo immediatamente presso l'unità dispiegata.
13. I volunteer to provide clinical services in crises. (R)*	13. Mi offro volontario per fornire servizi clinici in caso di crisi. (R)*
14. Rescuing the injured person motivates me.	14. Portare in salvo una persona ferita mi motiva.
15. The satisfaction of the injured person motivates me.	15. La gratitudine della persona ferita mi motiva.

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English version	**Italian version**
16. I am get motivated by participating in decision making.	16. Partecipare nel prendere le decisioni mi rende motivato.
17. After hard and difficult missions I use humor to smooth the situation.	17. Dopo situazioni difficili utilizzo l'umorismo per stemperare la tensione.
18. I am sympathetic to my colleagues.	18. Sono comprensivo verso i miei colleghi.
19. At the scene of the incident, the behavior of the injured person and his companions is not understandable to me. (R)*	19. Sulla scena del disastro, il comportamento del ferito e dei suoi compagni mi risulta incomprensibile. (R)*
20. At the scene of the incident I will cooperate with my colleagues, firefighting personnel and police in a professional manner.	20. Sulla scena del disastro voglio collaborare in maniera professionale con i miei colleghi, i vigili del fuoco e la polizia.
21. I am nervous and hurried at the time of delivery of the injured person to the hospital emergency staff.	21. Mi sento nervoso e preoccupato al momento della consegna del ferito al personale medico dell'ospedale.
22. I enter into the scene of incident with faith in God.	22. Entro sulla scena del disastro con fede in Dio.
23. In the face of accidents, I will pray.	23. Davanti ad un disastro, io pregherò.
24. My colleagues support me.	24. I miei colleghi mi danno supporto.
25. My colleagues advise me on solving the problems arise from missions.	25. I miei colleghi mi aiutano a risolvere i problemi che nascono in missione.
26. Having past experiences has made me cope with the scene of incidents.	26. Aver avuto esperienze in passato mi aiuta a far fronte alla scena del disastro.
27. Before arriving at the scene I will make a mental image of the scene of the incident.	27. Prima di arrivare sulla scena del disastro mi costruisco una rappresentazione mentale della scena stessa.
28. I will evaluate the safety and security of the scene before entering the scene.	28. Valuto la sicurezza della scena prima di entrarci.
29. I see the nightmare of my missions.	29. Ho gli incubi sulla mia missione.
30. I have trouble sleeping. (R)*	30. Ho problemi a dormire. (R)*
31. I use medication to control my stress.	31. Faccio uso di medicinali per controllare il mio stress.

*(R) indicates the item is reverse scored.

EMSRS Factors

Job motivation
1. I participate in missions without motivation.
2. I am biased towards my career.
3. I stay in the organization because I have no other choice.
4. I try to get the injured person quickly to a medical center.
5. I do my best all along the mission to survive the injured person.
11. In every situation, I will volunteer to save lives.
12. In case of close proximity to the accident site, I am immediately notified to the unit of deployment.
13. I volunteer to provide clinical services in crises.
14. Rescuing the injured person motivates me.
15. The satisfaction of the injured person motivates me.
16. I am get motivated by participating in decision making.
17. After hard and difficult missions I use humor to smooth the situation.
18. I am sympathetic to my colleagues.

Self management
6. I trust in my judgments and decisions on the scene of the incident.
7. I am responsible for what will happen to the injured person.
8. I control the challenges in the scene of the incident.
9. I can properly resolve the problems caused by missions.
26. Having past experiences has made me cope with the scene of incidents.

Remaining calm
10. At the scene of the incident, I want everyone to keep peace.
22. I enter into the scene of incident with faith in God.
23. In the face of accidents, I will pray.
27. Before arriving at the scene I will make a mental image of the scene of the incident.
28. I will evaluate the safety and security of the scene before entering the scene.

Communication challenges
19. At the scene of the incident, the behavior of the injured person and his companions is not understandable to me.
20. At the scene of the incident I will cooperate with my colleagues, firefighting personnel and police in a professional manner.
21. I am nervous and hurried at the time of delivery of the injured person to the hospital emergency staff.

Social support
24. My colleagues support me.
25. My colleagues advise me on solving the problems that arise from my missions.

Consequence of sress
29. I see the nightmare of my missions.
30. I have trouble sleeping.
31. I use medication to control my stress.

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