Medical Care in Disasters

Threats, Challenges and Solutions

Elhanan Bar-On MD,MPH
Israel Center for Disaster Medicine
and Humanitarian Response
Sheba Medical Center

Mass Casualty Event

- Patient treatment is affected by the needs of other patients
- Hospital function disrupted

- Necessitates a change in SOPs & operational modes

- Necessitates Expansion to Surge Capacity

Disaster

"Mega Mass Casualty Event"

Situation or event which:

- Overwhelms local capacity
- Causes Loss of Autonomy
- Necessitates External Assistance.

Event Severity

Compensated

- Mass Casualty Incident
- Casualty load < resources mobilised

Uncompensated

- Disaster, Catastrophe

- Additional medical resources mobilised are inadequate to treat the casualty load

AUSMAT
SURGICAL TEAM
COURSE

Event Severity

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- Mass Casualty Incident
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Uncompensated

- Disaster, Catastrophe

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AUSMAT
SURGICAL TEAM
COURSE

Disaster Severity

Simple

- Infrastructure, roads, hospitals, lines of communication intact

Compound

- Damaged infrastructure, roads, power supply, communications
- Disorganised health system

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SURGICAL TEAM
COURSE

Natural Disasters

- Geological: earthquake, tsunami, volcano, landslide, avalanche
- Meteorological: storms/typhoon/ hurricane, flood, fire, drought, environmental (extreme heat or cold)
- Biological: epidemic, famine, pests

Man Made Disasters

- Technological failure:
  - Industrial
  - Transport
- Fire
- Famine
- Mass-gathering – Collapse, Fire, Stampede
- Armed Conflict:
  - War
  - Terrorism
  - Refugee

NATECH Disasters

- Technological Disasters Triggered by Natural Events
  - Fires
  - Oil Spills
  - Hazmat escape
  - Nuclear Leaks

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SURGICAL TEAM
COURSE

Needs

- Mortality – Bury the Dead
- SAR – Rescue the Living
- Treat the Injured & Sick

- Food + Water
- Shelter
- Security
- Emotional Trauma

Capabilities

- Underserved Regions Often Affected

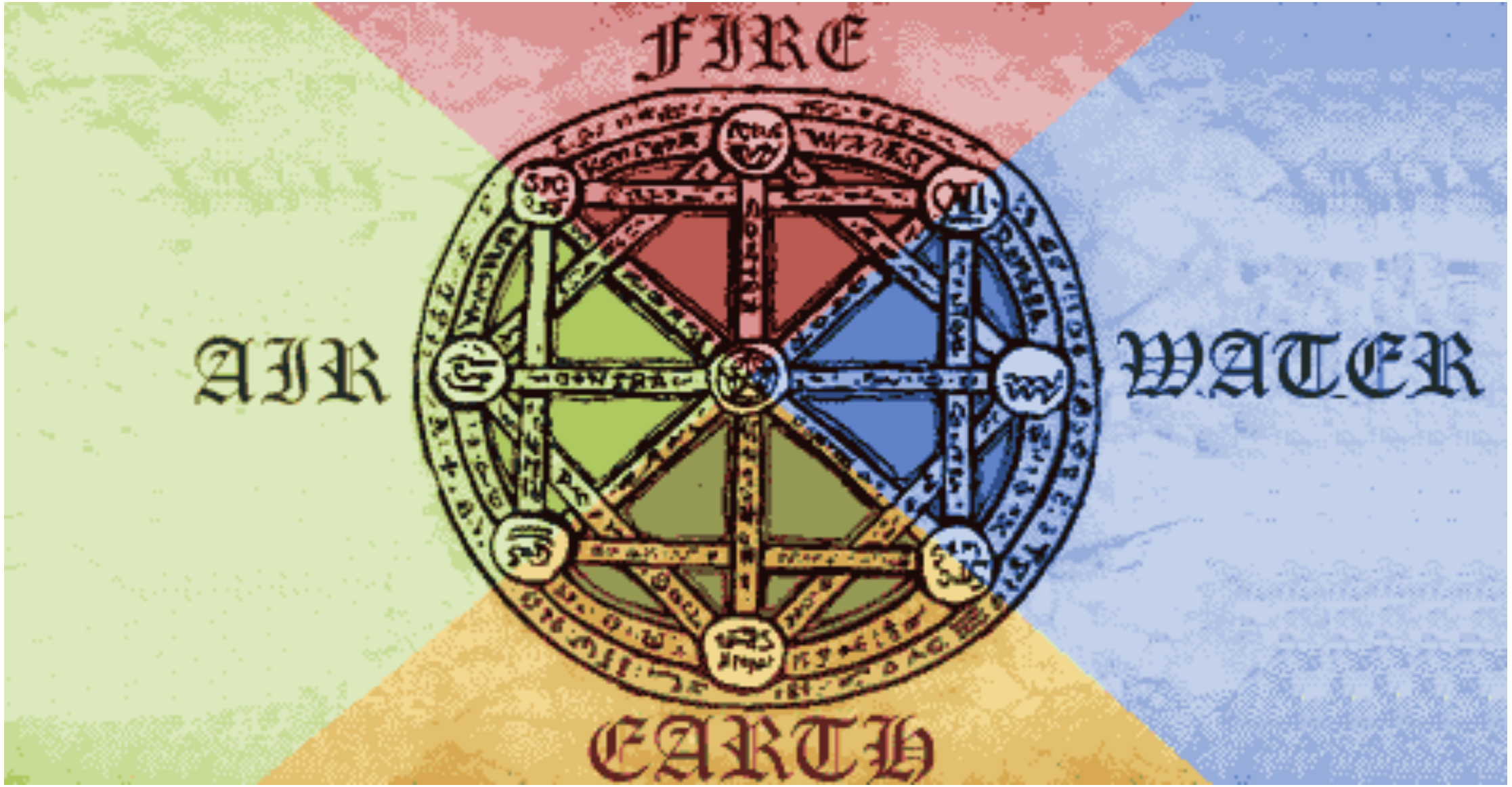
Capabilities

- Low Baseline Capabilities of Local Health System

Medical Services

- Infrastructure Damage
- Personnel Affected

Natural Disasters - Causes of Casualties



AIR

WATER

FIRE

EARTH

Disaster Pathophysiology

Energy Release

- Mechanical
- Thermal
- Chemical

Radiologic

Disaster Effects

- Environmental
- Logistic

Health

- Mortality

- Morbidity
  - Medical
  - Surgical

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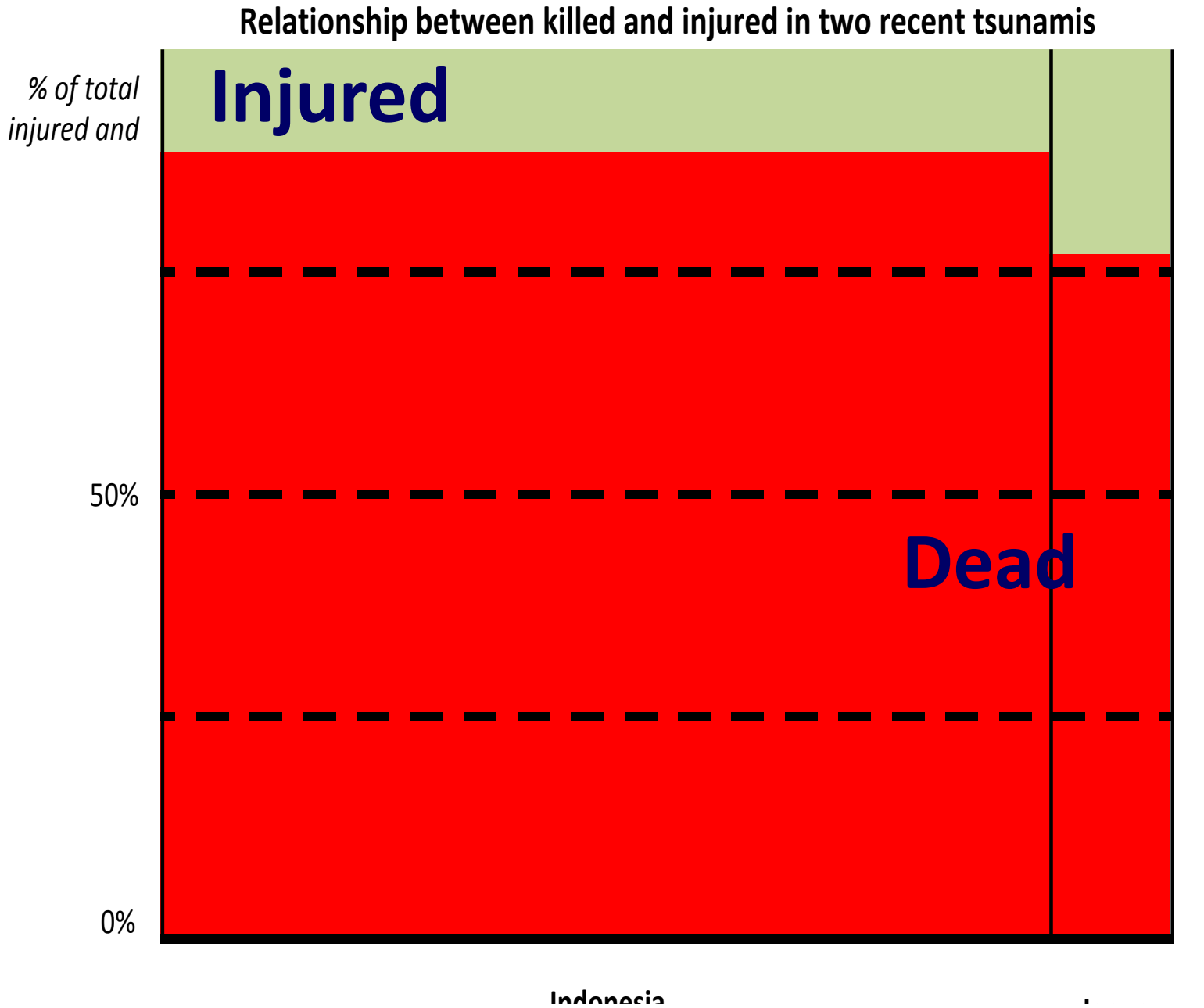
COURSE

- Tsunami - Environmental / Logistic Damage
  - Sudden Onset
  - Mechanical Energy
  - Water Damage
  - Structures
  - Electricity
  - Electronics
  - Communications
  - Transportation
  - WASH

Tsunami

- Medical
  - Aspiration
- Surgical
  - Fractures
  - Lacerations



- Volcano - Environmental / Logistic Damage
  - Sudden Onset + Continuous Eruptions
  - Usual Previous Experience
  - Limited Area
  - Thermal Damage
  - Mechanical Energy
    - Structures
    - Electricity
    - Transportation
    - WASH

Volcano

Death:Injury=16:1

- Medical
  - Inhalation
- Surgical
  - Burns
  - Crush Injuries

Storms

- Tornado
- Typhoon / Hurricane / Cyclone

- Storms - Environmental / Logistic Damage
  - Meteorological Forewarning
  - Mechanical Energy
  - Water Damage
  - Structures
  - Electricity
  - Communications
  - Transportation
  - WASH

Storms

- Medical
  - Interuption of Care
- Surgical
  - Fractures
  - Lacerations
  - Puncture Wounds

Floods

- Floods - Environmental / Logistic Damage
  - Gradual Onset
  - Meteorological Forewarning
  - Water Damage
  - Structures
  - Electricity
  - Communications
  - Transportation
  - WASH

Floods

- Medical
  - Drowning
  - Hypothermia
- Surgical
  - None

- Droughts - Environmental / Logistic Damage
  - Chronic
  - Lack of Water Infrastructure
    - Crops
    - Livestock

Drought

- Medical
  - Dehydration
  - Heat Exhaustion /Stroke
- Surgical
  - None

- Blizzard - Environmental / Logistic Damage
  - Gradual Onset
  - Meteorological Forewarning
    - Transportation
    - Electricity
    - Communications
    - Pipelines

Cold / Blizzard

- Medical
  - Exposure
  - Hypothermia
  - Dehydration

- Surgical
  - Frostbite

Outbreak

- Outbreak - Environmental/Logistic Implications
  - Gradual Onset
  - Public Health
    - WASH Infrastructure
  - Social Issues
    - Workforce
    - Public Institutions

- Outbreak – Health System Implications
  - Hospital Organization
    - Specialized Centers
    - Structural Requirements
    - SOPs

Outbreak – Health System Implications

- Hospital Organization
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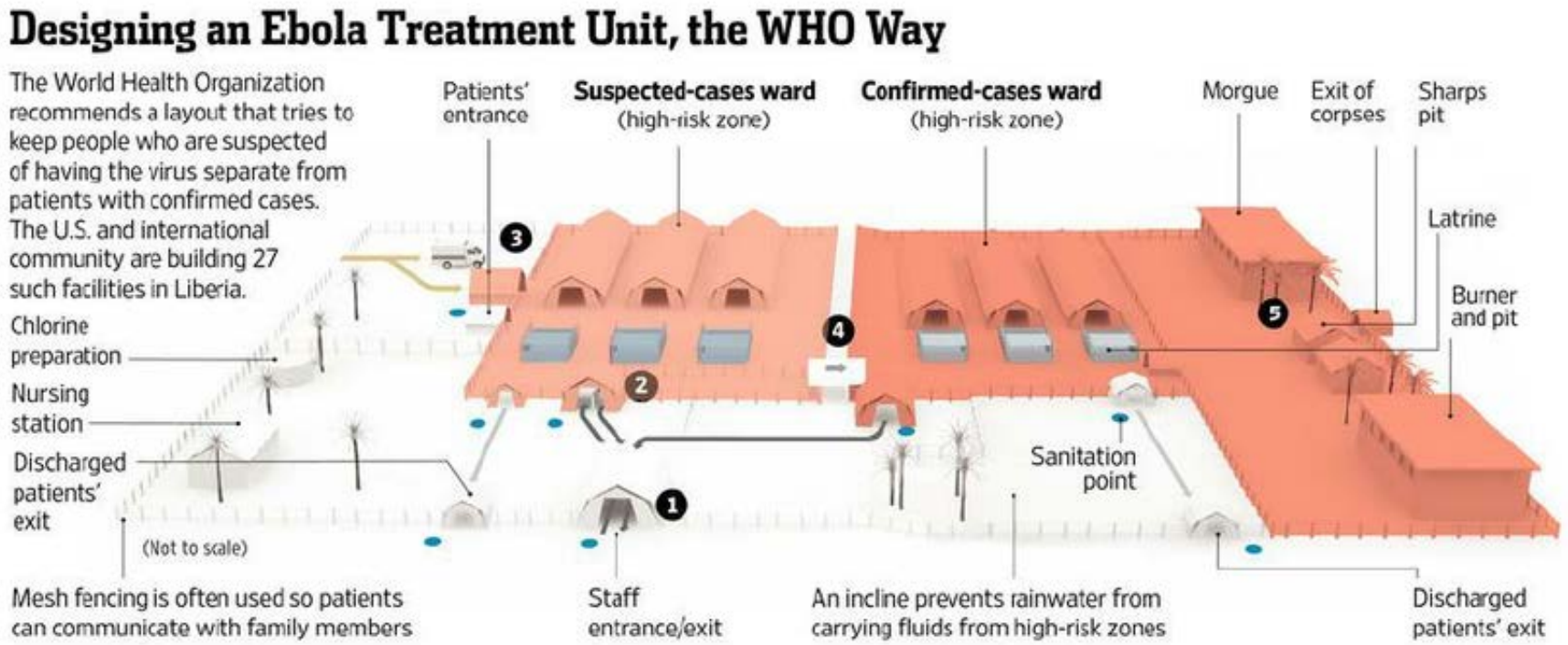
  - SOPs



- Medical
  - Disease Specific
    - Expertise
    - Medications
    - Equipment

- Medical
  - Disease Specific
    - Expertise
    - Medications
    - Equipment

Disaster Pathophysiology

Biologic

- Outbreaks
- Wound Infections

Outbreak

Outbreak – Health System Implications

- Public Health
  - Vaccinations & Medications

- Outbreak – Health System Implications
  - Hospital Organization
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Outbreak – Health System Implications

- Hospital Organization
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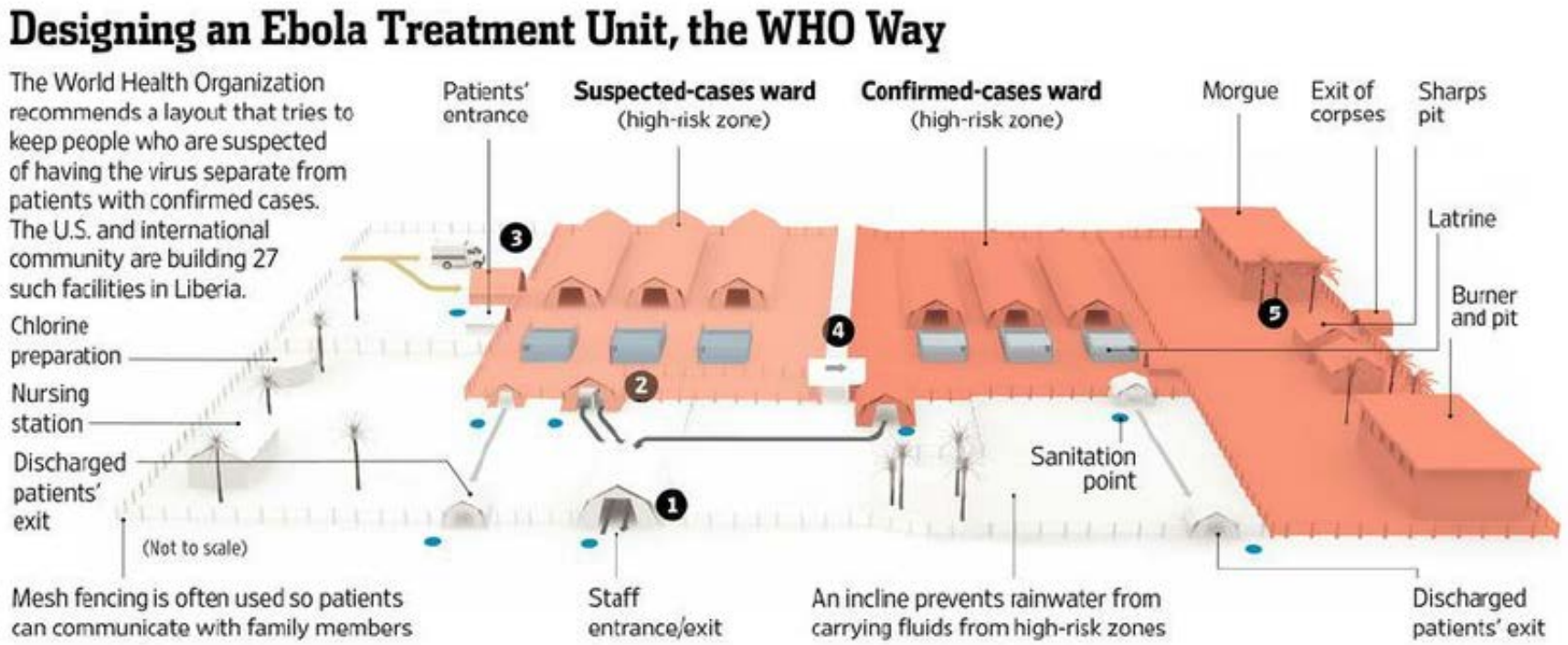


Load Summary

Medical Load

- Famine
- Outbreaks
- Pandemics

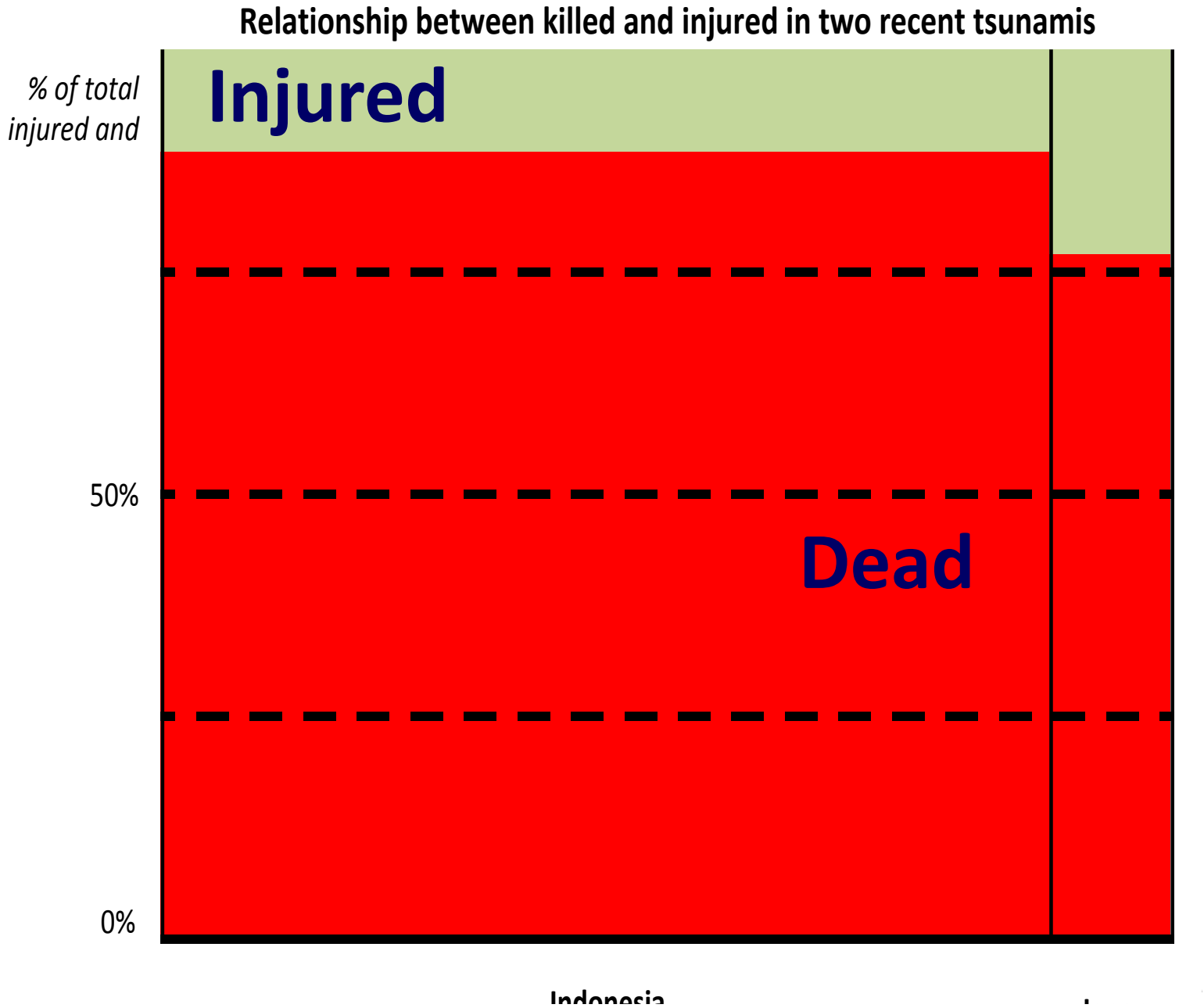
Surgical Load

- Earthquakes
- Conflicts

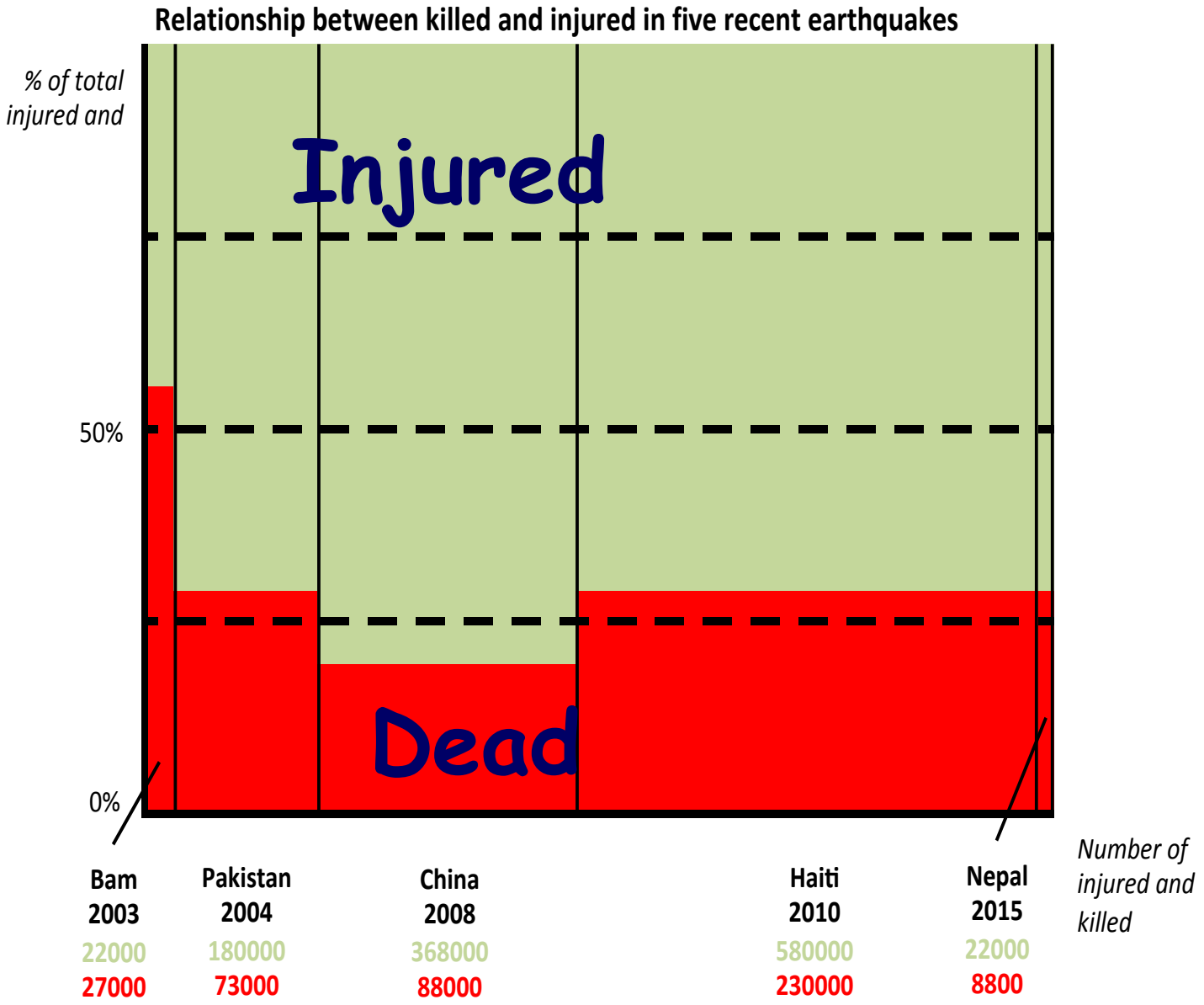
Earthquake Injuries>>>Other Disasters

Tsunami

- Medical
  - Aspiration
- Surgical
  - Fractures
  - Lacerations



Earthquake Injuries>>>Other Disasters



- Huge Amount of Energy

- Mostly Mechanical

Sudden Onset Disaster (SOD)

- No Forewarning
- All Energy Released in a few Seconds

Casualties Caused by:

- Falling Debris

"Earthquakes don't kill people.
Buildings do"

Casualties Caused by:

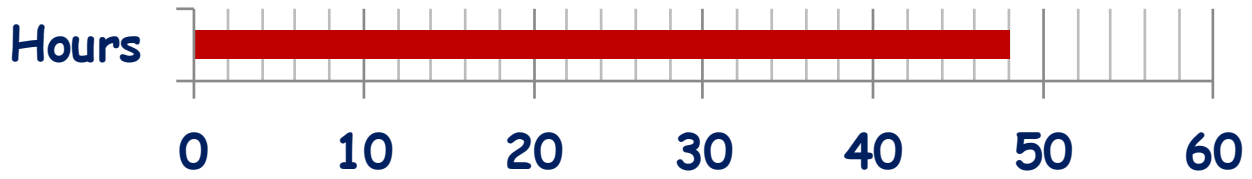
- *Falling Debris*
- *Jump / Fall from Height*
- *Dust Inhalation*
- *Burns*

Injuries Following Earthquakes Affecting Factors

- Earthquake Magnitude
- Depth of Epicenter
- Hour in Day of Earthquake
- Distance from Population Center
- Urban vs Rural
- Type & Quality of Buildings
- Hazmat Escape

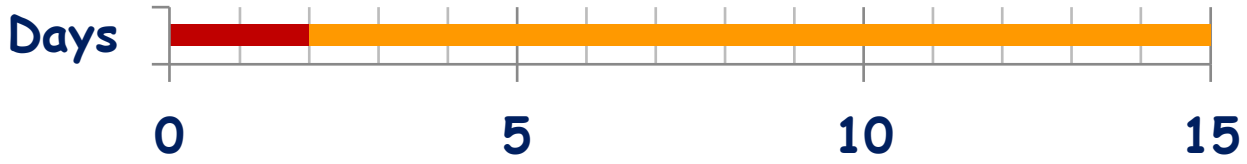
Post Earthquake Phases

- Phase I: Day 1-2
  - Life Threatening Injuries Salvageable
  - Breakdown of Local Infrastructure
  - Foreign Medical Teams Not Yet arrived



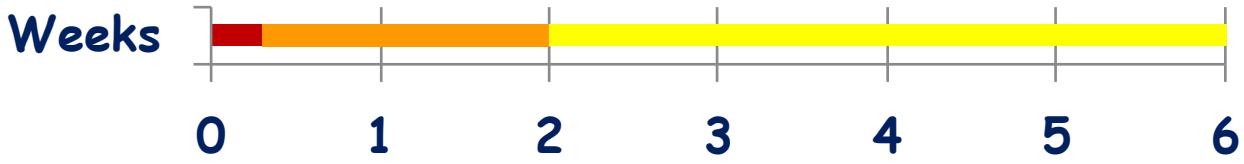
Post Earthquake Phases

- Phase II: Days 3-15
  - Many Foreign Teams Operational
  - Life Threatening Injuries Perished or treated
  - Predominant Fractures
  - Open Infected Wounds
  - Beginning of Routine Medicine



Post Earthquake Phases

- Phase III: 2-6 weeks
  - Shift to Routine Medicine
  - Possible Epidemics
  - Trauma Residua +Early Rehabiitation
  - Foreign Teams Depart
  - Recovery + Establishment of Larger Facilities



Hospital Overload

Medical Infrastructure Damage

Medical Infrastructure Damage

Medical personnel Affected

- Killed or Injured
- Searching / Caring for Family

- Underserved Regions Often Affected

- Low Baseline Capabilities of Local Health System

- Number and Severity of Injuries
- Treatment Capabilities

Massive International Aid Response

- 300 Foreign Medical Teams

WHO
Emergency Medical Team Initiative

Type 1 EMT - Ambulatory Care

Mobile

Fixed

Type 2 EMT
Diagnostics, Basic Surgery

Type 3 EMT
Specialized Surgery + Intensive Care

Operational Medical Facilities

- Ambulatory Treatment Point / EMT 1
  In the Disaster Focal Point
- Emergency Medical Teams – EMT 2/3
  Local + International
- Primary-Dispatching Hospital
  In the Disaster Zone
- Receiving Hospital
  Remote from the Disaster Zone

Operational Medical Facilities

- Primary-Dispatching Hospital In the Disaster Zone
- Receiving Hospital
  Remote from the Disaster Zone
- Emergency Medical Teams – EMT 1/2/3
  Local + International
-

Primary–Dispatching Hospital

- Structure Damaged
- Reduced Capabilities

- Essential Components Functional: ER, OT,ICU, Imaging,Lab,Blood Bank

Primary–Dispatching Hospital

- Patient Feed from Type 1+ Direct

- Hospital flooded
  beyond
  Surge Capacity

- Evacuation
  Difficulties

Receiving Hospital

Receiving Hospital

- Remote from Disaster Zone
- Infrastructure Unaffected
- Full Capabilities Preserved
- Surge Capacity +50% Beds & OTs
- Medium Hospital: 300-400 pts
- Large Hospital 800-900 pts

Receiving Hospital Capabilities

- Longer Operations
- Advanced Imaging
- Definitive Fracture Fixation
- Secondary & Reconstructive Procedures
- Increased ICU
- Hemodialysis

Change Priorities due to Overload

Shortages

- Space Shortage
  - Emergency Department

Shortages

- Space Shortage
  - Emergency Department
  - Wards

Shortages

- Space Shortage
  - Emergency Department
  - Wards
  - Operating Theatres

Shortages

- Space Shortage
  - Emergency Department
  - Wards
  - Operating Theatres
  - Recovery
  - ICU

Shortages

- Personnel Shortage
  - Traumatologists
  - Surgical Subspecialties
  - Pediatrics
  - Anesthesiologists
  - Nurses

Shortages

- Equipment Shortage
  - Fixation Hardware
  - Surgical & Power Instruments
  - Autoclave
  - C Arm Fluoroscopy

Conceptual "Change Diskette"

Hospital

- Organization
- Logistics

Treatment

- Priorities
- Treatment Methods
- Ethical Considerations

- Single Patient
- Routine Time
- Fully Equipped Hospital

- Disaster Scenario
- Infrastructure Damage
- Health System Overwhelmed

Clinical Solutions

Early
Total
Care

Damage
Control
Surgery

Damage Control in MCI, Disasters and Austere Environments

Rationale for DamageControl:

Greatest Good for the *Greatest Number*

NOT

Everything for Everyone

Triage

(Fr.) = Separate, Sift, Select)

Prioritizing Treatment of Patients according to:

- Severity of Patient's Condition
- Available Resources

Orthopedic Damage Control Surgery

"Life Over Limb"

Minimal surgery for fracture stabilization in physiologicaly unstable multitrauma patient

- Optimize Surgical Efficiency
  - Avoid Long Procedures

Regional Anesthesia/Conscious Sedation

→ *Decrease Recovery Room Stay*

Hospital Organization & Logistics

- Increase hospitalization capacities
- Increase surgical capabilities
- Maximize resource utilization

Earthquake: General Hospital→ "Orthopedic Hospital"

- Geographic Changes

- 2 Tables in Theatre

Logistic Solutions

- Field Hospital on hospital grounds
  - Combining forces
  - Utilization of existing infrastructure

Concept Change:
Surgery in Re-designated Areas

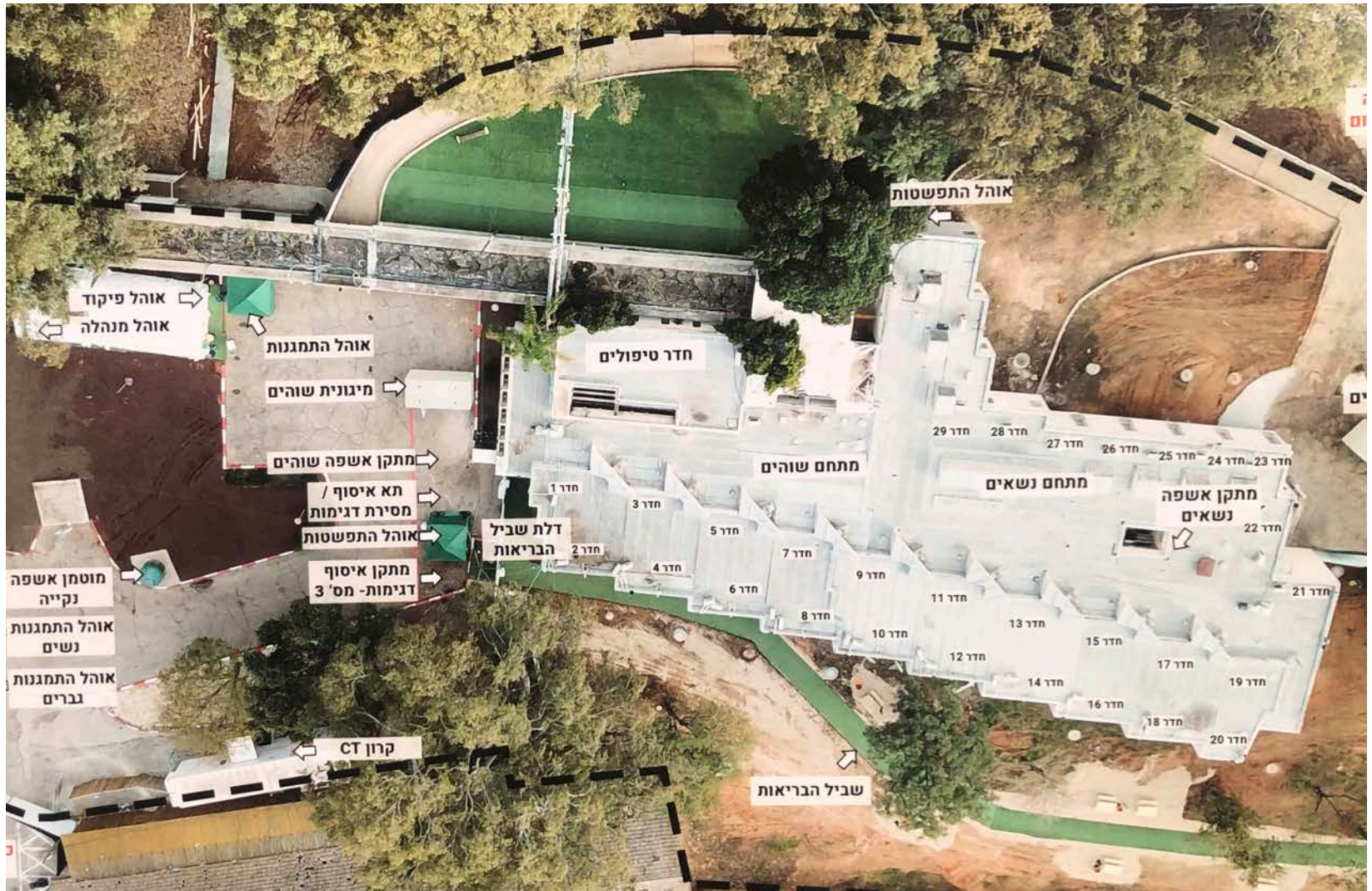
- Port Au Prince - Haiti

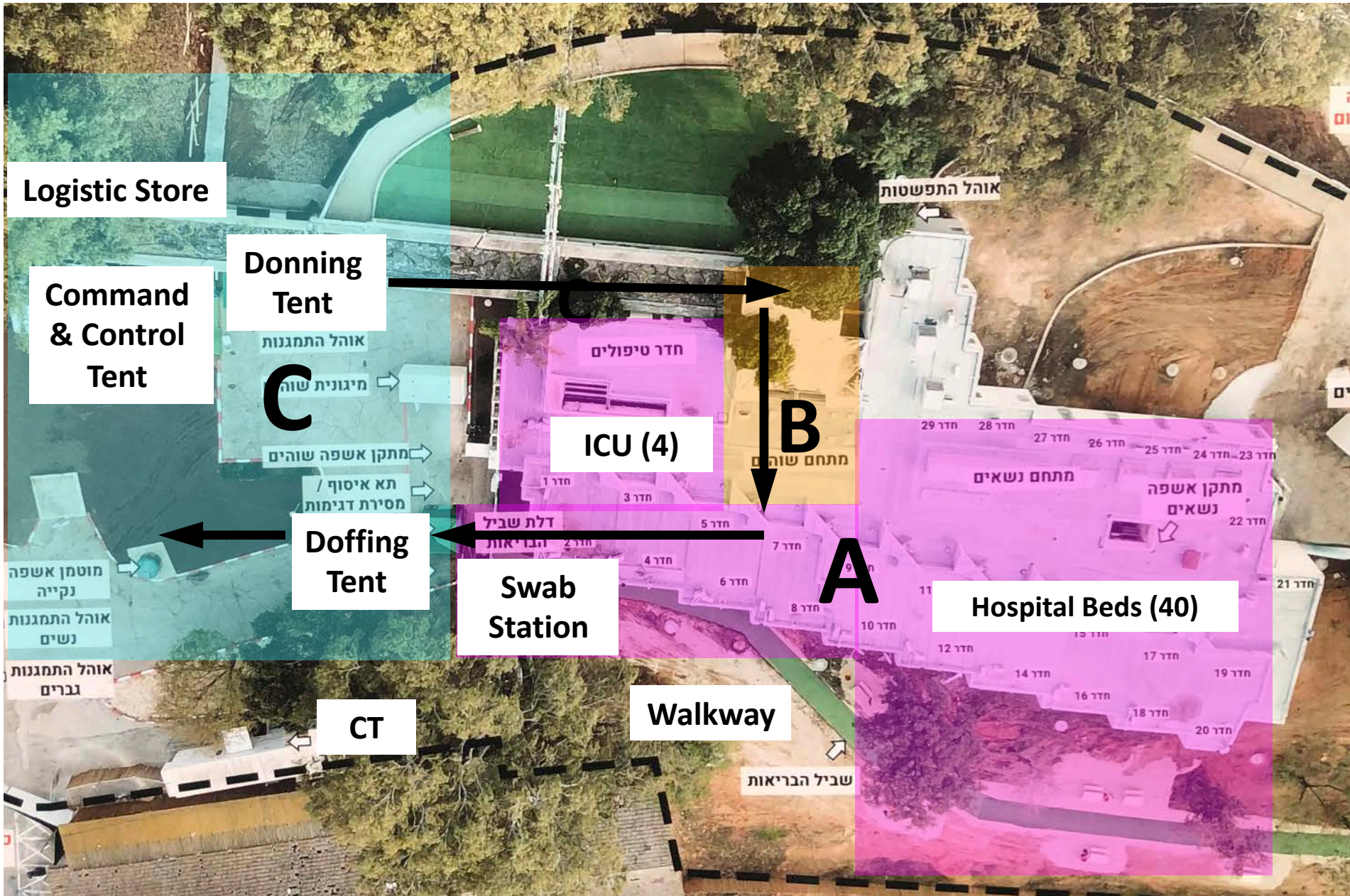
- Shri Birendra
  Military
  Hospital
  Kathmandu

Pre-Map Potential Alternative Sites

- Surgical Areas
- ICU
- Lab
- Blood Bank

- **Staff quarters → COVID facility**




Logistic Store
Command & Control Tent
Donning Tent
Doffing Tent
Swab Station
ICU (4)
Hospital Beds (40)
Walkway
CT
A
B
C
אוהל התפשטות
חדר טיפולים
מתחם נשאים
מתקן אשפה נשאים
מתחם שוהים
דלת שביל הבריאות
שביל הבריאות
אוהל התמגנות
מיגונית שוהים
מתקן אשפה שוהים
תא איסוף / מסירת דגימות
מוטמן אשפה נקייה
אוהל התמגנות נשים
אוהל התמגנות גברים

Food & Supplies (Ambulatory pts.)

- Double door cubicles
- Timed by CCC

Swab Testing

- Across Window
- No patient Contact
- Specimen collection in cubicle

Underground Parking Lot → CCCU

100 Bed Critical Care Corona Unit

Underground Parking Lot → CCCU

100 Bed Critical Care Corona Unit

Area Out of Main Hospital

- Superficial Wounds
- Closed Light Injuries
- Stress Disorders

Patients Delayed in Area Out of Main Hospital

- Superficial Wounds
- Closed Light Injuries
- Stress Disorders
- Morgue

Severely Injured Patients with Poor Chance of Survival

- Separate Enclave for Palliative Treatment

Preparation Before the Crisis

Logistic Planning

- Organisation of Space
- Organisation of Infrastructure
- Organisation of Equipment
- Organisation of Supplies

Preparation before the crisis

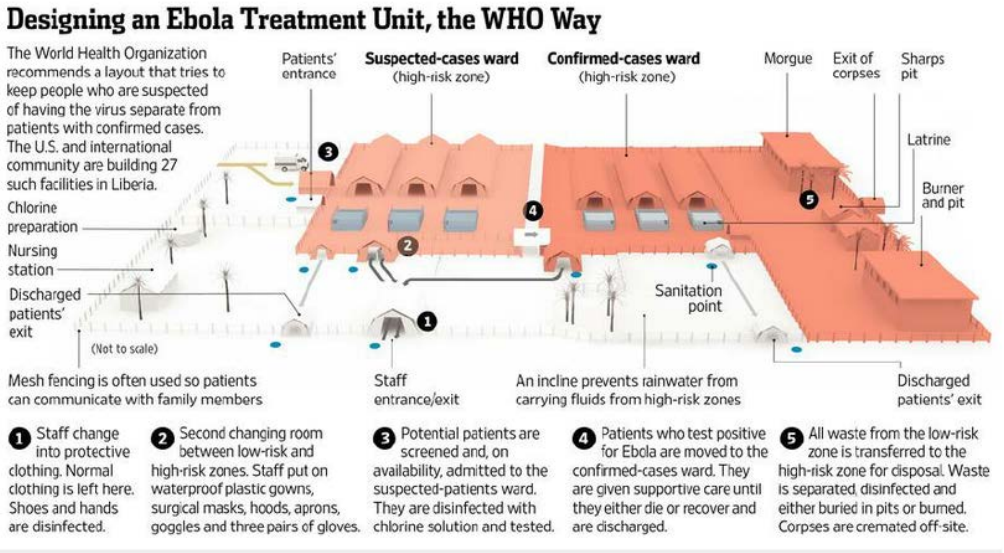
Requires:

- Planning
- Training
- Drilling

Initial Drill

Construction of Tented Model of COVID-19 Facility

- WHO – Ebola principles
- Clean, intermediate & contaminated zones



Drill

- Work-flow
- Patient-flow
- Logistics
- Patient transfer from/to main hospital

Stage 3 - With Establishment of COVID-19 Facility

- Off-Site in MSR
- On-Site in facility – "System Check" before patient upoccation

Stage 3 - With Establishment of COVID-19 Facility

- Simulation-based Telemedicine Training:
  - Staff
  - Patients & families

Solution: Task Shifting

Establishment of Mechanical Ventilation Support/Reinforcement Unit

- 300 Staff members
- 60 Multi-disciplinary teams

MSR Just-in-Time Training Program

Preparation before the crisis

- Organisation of the personnel
  - SOPs
  - Call Roster
  - Ward Evacuation Plan (Reverse Triage)

Earthquake: General Hospital→ "Orthopedic Hospital"

Personnel Implications:

- Task Shifting

Preparation before the crisis

Logistic Planning

- Organization of the space

- Organization of Infrastructure

Preparation before the crisis

Requires:

- Planning
- Training

EMT – Israeli Experience

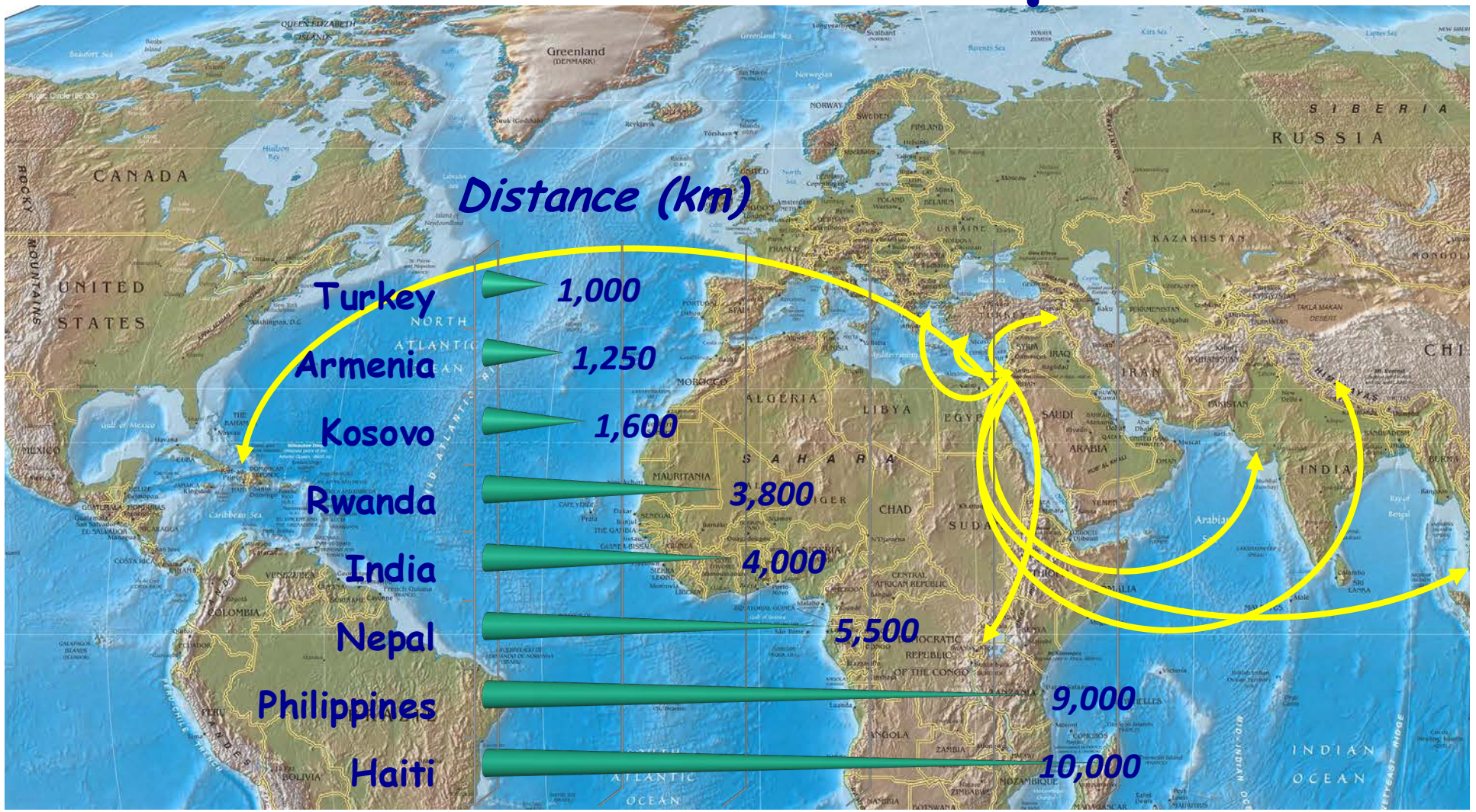
Israeli Defense Forces (IDF)

IDHM (Sheba MC)

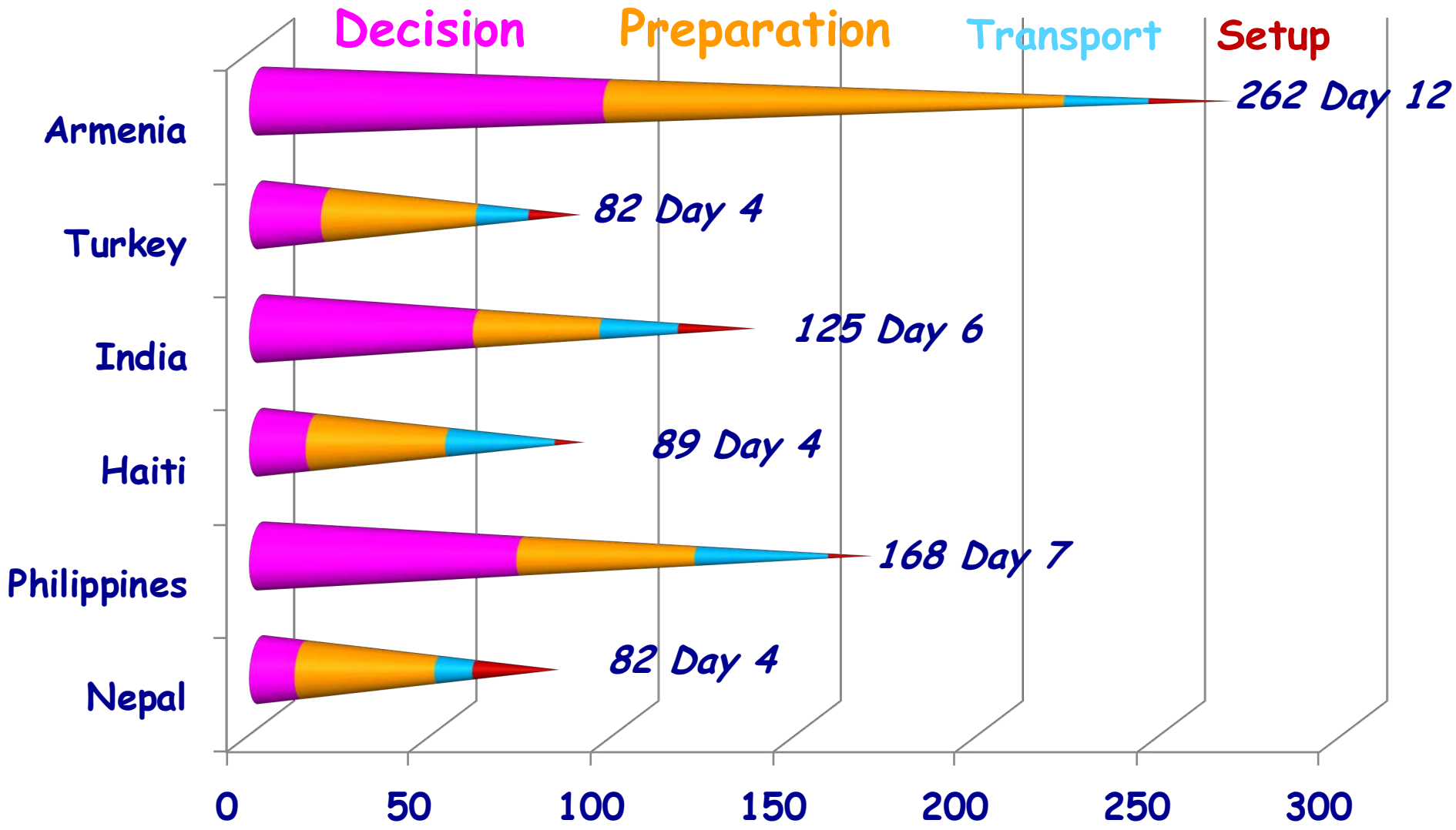
IDF Aid Missions

1968 Sicily *Earthquake*
1979 Cambodia *Refugees*
1985 Mexico *Earthquake*
1986 Cameroon *Gas Eruption*
★ 1988 Armenia *Earthquake*
1989 Russia *Train Accident*
★ 1994 Rwanda *Refugees*
1994 Argentina *Bombing*
1998 Kenya *Bombing*
★ 1999 Kosovo *Refugees*
★ 1999 TurkeyX2 *Earthquakes*
1999 Greece *Earthquake*
★ 2001 India *Earthquake*
★ 2010 Haiti *Earthquake*
2011 Japan *Tsunami*
★ 2013 Philippines *Typhoon*
★ 2015 Nepal *Earthquake*

Deployment
Distance & Transport



Initiation of Operation Hours from Event



January 12, 2010
16:53

Magnitude: 7.0
Epicenter:
25 km W. of Port au Prince
Depth: 10 km

Haiti 2010

- No Local Health System
- No Evacuation Destination
- Stand Alone Field Hospital

Nepal 2015 – Magnitude 7.8

- Epicenter 80 km from Kathmandu
- Depth 15 km

- 160,000 Buildings destroyed
- 9 Million people affected
- 2.8 Million homeless
- 9,000 Killed
- 23,000 Injured

- Whole Villages Destroyed
- Severe Road Infrastructure Damage
- Land Evacuation Difficult

Nepal 2015

- Injuries +++
- Functional Medical System

- Evacuation FROM Rural areas to Field Hospital

- Full Collaboration with Functioning Medical Facility
- Mixed Teams
- Patient Distribution according to Hospital Capabilities

The Israel Center for Disaster Medicine and Humanitarian Response

Est. 2017

SHEBA
Tel HaShomer
City of Health

The Vision

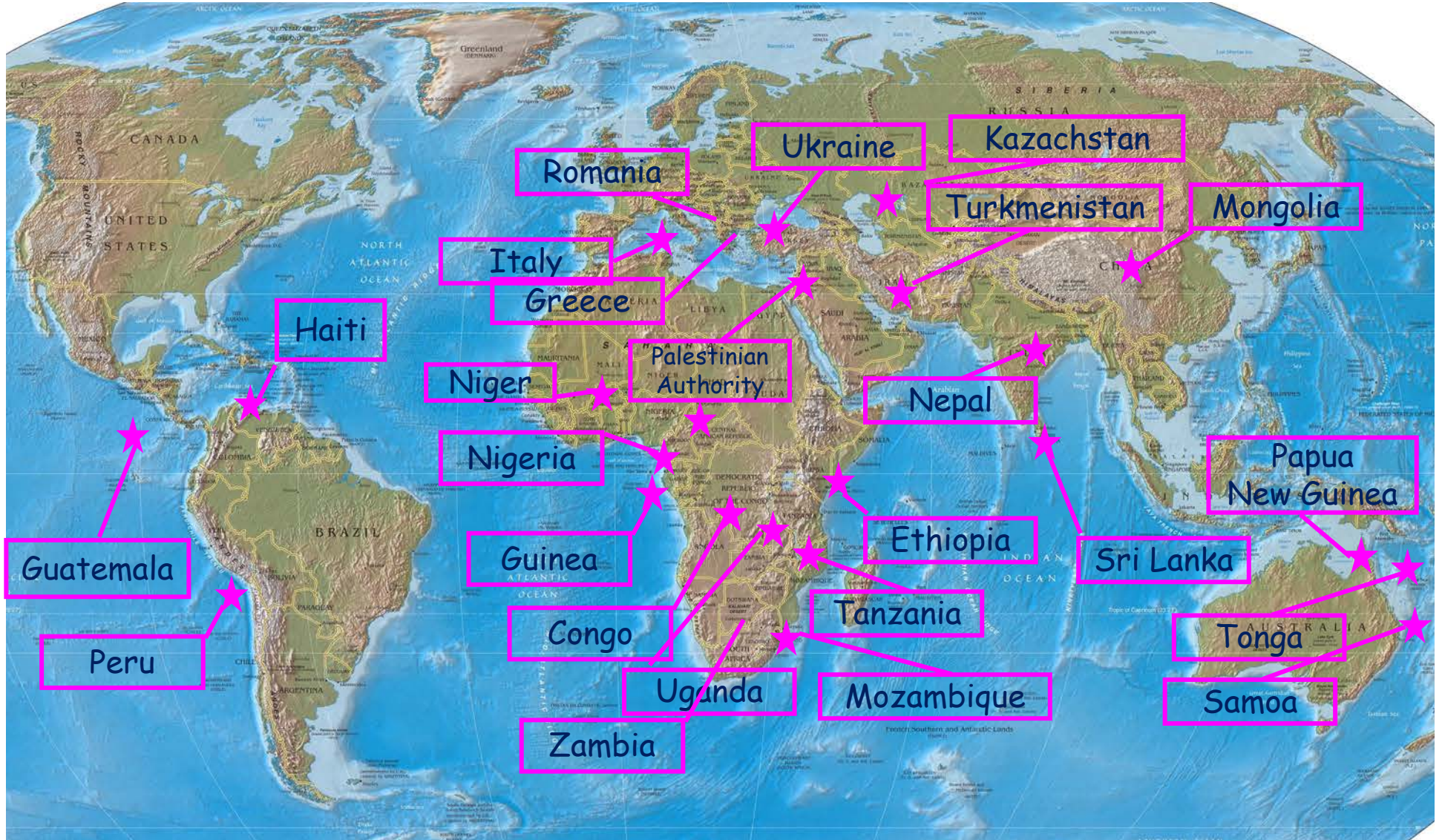
A World Center of Excellence Dedicated to Medical Preparedness and Response in Disaster Areas, Emergency Situations, & Humanitarian Aid

Activities

- Disaster Deployment
- Humanitarian Missions
- Teaching & Training
- Research & Innovation

Worldwide Activity

SHEBA
Tel HaShomer
City of Health



Zambia 2018 – Cholera Outbreak

Papua New Guinea 2018

Cataract Surgery

Nigeria 2017- 2019

Pediatric Cardiac Surgery

Guatemala 2019 – Volcano Eruption

Samoa 2019 – Measles Outbreak

Mozambique 2019- Cyclone

Haiti 2020 - Burn Treatment

Sheba 2020

First Israel COVID-19 Facility

Palestinian Authority 2020

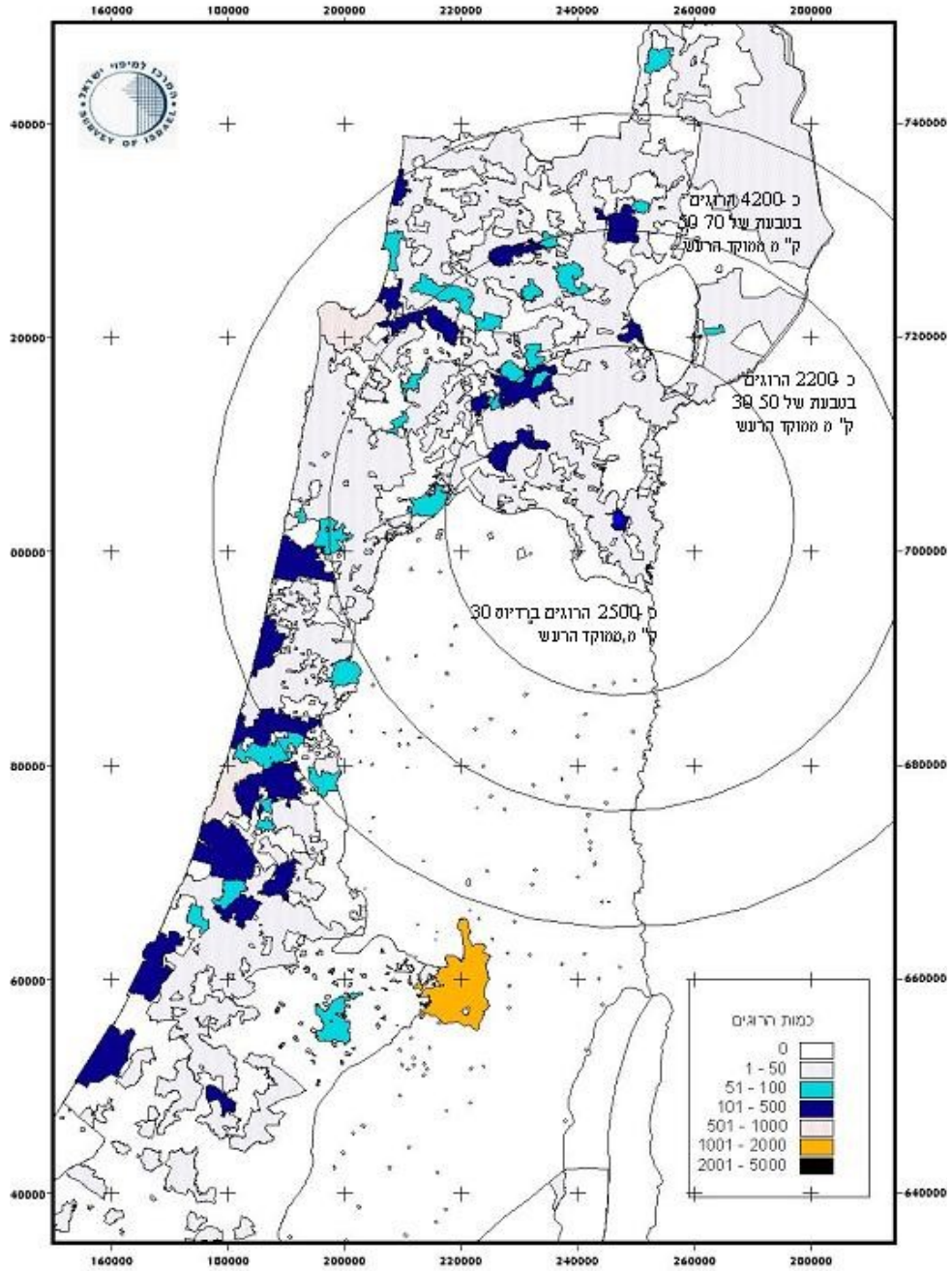
COVID-19 Training

Jericho

Gaza Strip

Greece 2020 - Refugee Crisis

Italy 2020 - COVID-19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60000
כ 4200 הרוגים
בטבעת של 70
ק" מ ממוקד הרעש
כ 2200 הרוגים
בטבעת של 50
ק" מ ממוקד הרעש
כ 2500 הרוגים ברדיוס 30
ק" מ ממוקד הרעש
כמות הרוגים
0
1 - 50
51 - 100
101 - 500
501 - 1000
1001 - 2000
2001 - 5000

Excpected Casualties (MOH)

Dead	7,000
Severe Injuries	8,600
Light Injuries	37,000
Displaced	170,000

+ Unknown Number of Post Trauma Stress Victims

Projected Medical Infrastructure Capabilities (MOH)

- 50% Decrease in Hospital Capacities
- 8,000-10,000 Available Beds
- Occupancy by 6,000 Injured & 4,000 Sick

Field Hospital on Sheba Grounds

Goal: Operational Continuity in case of Massive Structural Damage

Thank You

https://eng.sheba.co.il

Elhanan.Baron@sheba.health.gov.il

SHEBA
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City of Health

ISRAEL CENTER FOR DISASTER MEDICINE AND HUMANITARIAN RESPONSE
IDHM