

SAVING LIVES UNDERGROUND

THE CASE FOR UNDERGROUND HOSPITALS IN SYRIA

MAY 2017



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This report was authored by Kathleen Fallon, Senior Humanitarian Advocacy Lead at The Syria Campaign. Natasha Kieval, Advocacy Officer at the Syrian American Medical Society (SAMS), was a contributing author.

**ABOVE ALL,
WE WOULD LIKE
TO THANK AND
RECOGNIZE
THE HEALTH
WORKERS WHO
RISK THEIR
LIVES DAILY TO
TREAT OTHERS
IN SYRIA.**

SIGNATORIES TO THIS REPORT

The Syria Campaign
Syrian American Medical Society (SAMS)
Union of Medical Care and Relief Organizations (UOSSM)
Sustainable International Medical Relief Organization (SIMRO)
Independent Doctors Association (IDA)
Syria Relief & Development (SRD)
Syrian Expatriates Medical Association (SEMA)
Physicians Across Continents (PAC)
Hand in Hand for Syria
Syria Relief
Al Sham Humanitarian Foundation
White Smile
Human Appeal
United Medical Office of East Ghouta - Al Marj Sector

ABOUT THE SYRIA CAMPAIGN

The Syria Campaign advocates for the protection of civilians by elevating the demands of Syrian heroes. We are fiercely independent and are funded entirely by individuals and foundations.

Contact us info@thesyriacampaign.org



Physician working in the basement of the Aleppo Children's Hospital. Source: Independent Doctors Association

DEDICATION

DR. HASAN AL-ARAJ

1970 – 2016



“ THE THING I WOULD ASK FOR RIGHT NOW IS THAT THE WORLD ACTS IN ORDER TO PROTECT PATIENTS, LIKE WITH UNDERGROUND HOSPITALS. WE NEED PROTECTION.”

Dr. Hasan Al-Araj, former Hama Health Director and Co-Founder of Central Cave Hospital (1970-2016)

This report is dedicated to Dr. Hasan Al-Araj - cardiologist, co-founder of the Hama Health Directorate, and co-founder of the Central Cave Hospital in Hama, Syria. After systematic attacks on medical facilities in his area, Dr. Hasan built the innovative Central Cave Hospital, dug into the heart of a mountain. This hospital has protected the lives of countless medical staff and patients. On April 13, 2016, Dr. Hasan was killed outside of his hospital when the ambulance he was driving was targeted by a Russian or Syrian government airstrike.

We dedicate this report to Dr. Hasan and all health workers in Syria who have given their lives to treat and save others. We will never forget them and their selfless work.



**“ THE ONLY WAY TO PROTECT
MEDICAL STAFF IS UNDER
THE GROUND. THERE IS NO
OTHER WAY. OTHER THAN
TO STOP THE AIRSTRIKES
ON HOSPITALS.”**

Dr. Farida, OB/GYN at Omar bin Abdulaziz
(M2) Hospital, East Aleppo

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EXECUTIVE SUMMARY

“ WITH THE TARGETING OF OUR HOSPITALS, I DON’T THINK ANYTHING CAN PROTECT OUR MEDICAL STAFF EXCEPT BEING UNDERGROUND.”

Dr. Husan, Hospital Director at hospital in Idlib (unnamed for security)

Health facilities in Syria are systematically targeted on a scale unprecedented in modern history.

There have been over 454 attacks on hospitals in the last six years, with 91% of the attacks perpetrated by the Assad government and Russia.¹ During the last six months of 2016, the rate of attacks on healthcare increased dramatically. Most recently, in April 2017 alone, there were 25 attacks on medical facilities, or one attack every 29 hours.²

**APRIL 2017:
ONE ATTACK ON A HEALTH
FACILITY EVERY 29 HOURS**

While the international community fails to protect Syrian medics from systematic aerial attacks on their hospitals, Syrians have developed an entire underground system to help protect patients and medical colleagues as best they can. The fortification of medical facilities is now considered a standard practice in Syria. Field hospitals have been driven underground, into basements, fortified with sandbags and cement walls, and into caves. These facilities have saved the lives of countless health workers and patients, preserved critical donor-funded equipment, and helped prevent displacement by providing communities with emergency care. **However, while Syrian medics have adapted their operations to fit these unique horrors, international donor governments have not adapted their funding.**

Donors often see the reinforcement and building of underground medical facilities exclusively as long-term aid, or development work. However, as the Syria crisis is classified as a protracted emergency conflict, medical organizations do not currently have access to such long-term funds.



Construction on underground hospital in Hama, Syria. Source: IHH Humanitarian Relief Foundation

Budget lines for the emergency funding they receive can include “protection” work, but infrastructure building, even for protective purposes, often falls outside of their mandate. The divide between emergency humanitarian and development funding is creating a gap for projects that bridge the two, like protective measures for hospitals in Syria. Medics are paying the price.

“ IT COSTS LESS OVER TIME AND IS MOST EFFECTIVE TO BUILD UNDERGROUND HOSPITALS.”

Dr. Abdulkhalek, Ophthalmologist,
Al Hayat (M3) Hospital, East Aleppo

THIS REPORT EXPLORES THE FOLLOWING FINDINGS:



Underground hospitals are much, much safer.

They are proven to protect medical staff compared to above-ground facilities - while at least 814³ health workers have been killed in Syria since the beginning of the conflict, no health workers have been killed directly from an attack while working in a fully underground hospital.⁴



This is the #1 donor demand of Syrian health workers. Funds for fortified and underground hospitals are the number one protection recommendation coming from the Turkey-based 'Health Cluster' serving Syria, comprised of all major medical groups operating in Syria.



Three major models of underground hospitals have been developed. Syrian engineers and medics have developed three major models of underground hospitals - basement hospitals, cave hospitals, and fully underground hospitals.



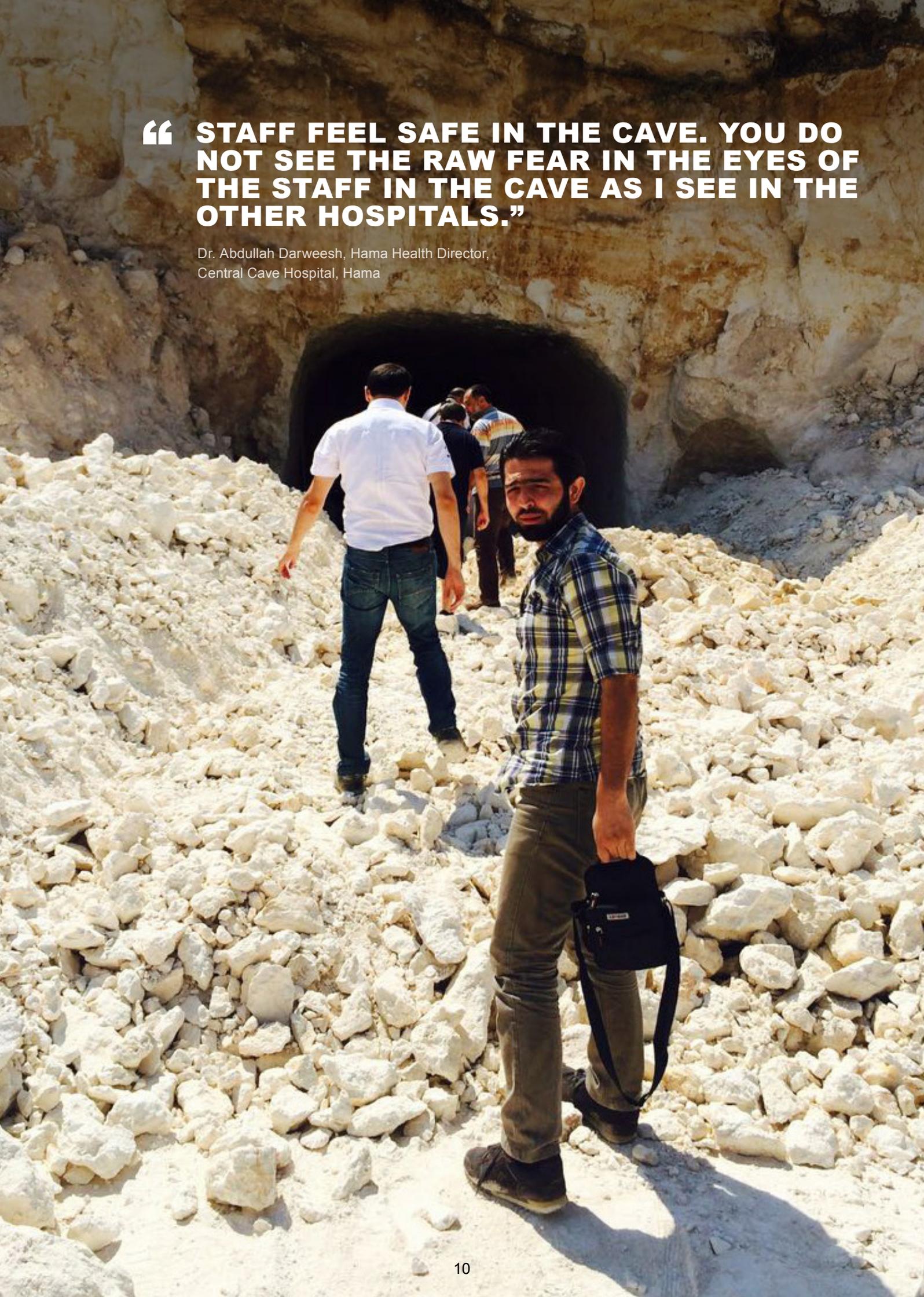
The need is immense. 50% of hospitals in opposition-held Syria have no measure of reinforcement or fortification, showing the scope of need.⁵



Protection is cost effective. The Idlib governorate is a priority area for fortification, especially as attacks using advanced weapons like bunker buster bombs and chemical weapons escalate. It costs only \$719,000 to re-fortify all of the existing priority facilities identified in Idlib.⁶

“ STAFF FEEL SAFE IN THE CAVE. YOU DO NOT SEE THE RAW FEAR IN THE EYES OF THE STAFF IN THE CAVE AS I SEE IN THE OTHER HOSPITALS.”

Dr. Abdullah Darweesh, Hama Health Director,
Central Cave Hospital, Hama



INTRODUCTION FROM SYRIAN MEDICS

OUR MESSAGE TO THE INTERNATIONAL COMMUNITY

We are 13 Syrian medical organizations, together treating and supporting millions of civilians inside of Syria each year.

Our hospitals have been targeted over 454 times in the last six years, with 91% of the attacks carried out by the Assad government and Russia.¹ More than 814 of our colleagues have been killed.³ Each day, we fear that barrel bombs, airstrikes, and chemical attacks will target our hospitals. Many hospitals have been hit upwards of a dozen times - in East Aleppo, the Omar bin Abdulaziz Hospital, or M2, was hit 14 times in the last six months of 2016⁷ before it was forced to close. In the last month, April 2017, there were 25 attacks on our medical facilities - an average of one attack every 29 hours.

We need these attacks to stop. We need protection.

We have called for the protection of hospitals and health workers from the beginning of the conflict. **It is we, as Syrian medics, who have treated patients under bombings.** When victims pour into our hospitals after barrel bombs drop on nearby neighborhoods, we have to choose which children will live or die. It is our colleagues, friends, brothers and sisters, who we fear for each day. **We cannot stress upon you how urgently the bombing of hospitals and civilian areas needs to stop, by any means necessary.**

To the international community - this is our message to you. We need you to act to prevent attacks on civilians and protect hospitals from the daily attacks we face from the sky.

Six years into this conflict, we have adapted our operations. We have learned from our experiences, and have worked with rescue workers, engineers, city planners, and across sectors to find ways to help protect ourselves from the worst of the bombings. We shifted our operations and trauma care into basements, so that we can treat patients underground. When air strikes and bombs targeted our hospitals, it was often because of the reinforcement of these underground basements that we survived. We then began

to think bigger - could we save staff and patients' lives, preserve critically needed medical equipment, and protect our facilities by moving them entirely underground and in caves? We were not alone in this thinking - today in Syria there are schools and playgrounds underground, and most secure homes have basements. There is now a network of underground medical facilities providing a full range of services to patients - incubators for newborn babies are housed in basements, and surgical theaters are built underground. **We have created an underground world to try to protect civilians from the Assad government and Russia's bombs.**

This is how we are saving ourselves while we save our patients.

We cannot tell all the stories of each of the brave medics whose innovation and dedication has saved lives, but we will mention one of them. Dr. Hasan Al-Araj, who was the last cardiologist in Hama and led the Health Directorate of Hama, conceptualized and built the Central Cave Hospital. After the destruction of many hospitals in the Hama countryside by airstrikes, Dr. Hasan thought it safest to work in a cave. He spearheaded the Central Cave Hospital, finding the location and using his own funds to make sure that the project was completed. It took over a year to build, in the heart of a mountain, under 20 meters of pure rock. It has saved countless lives since it opened.

A year ago, in April 2016, as Dr. Hasan left the Central Cave Hospital, an Assad government or Russian missile targeted his ambulance. He was killed. We found pieces of his white medical coat in the wreckage.

For those of us who knew Dr. Hasan, we know what he most wanted - he wanted his patients and staff to be protected. He was willing to dig a hospital in a cave to save their lives. This will forever be his legacy. We will never stop advocating for an end to these attacks on health workers, or for the methods of protection Dr. Hasan innovated.

But while we have adapted our operations to fit the unique horrors of the conflict in Syria, donors have not adapted their funding. Government donors often see the fortification and rebuilding of medical facilities through the lens of development, not emergency protection. Development funding is rarely given to projects in opposition-held Syria, where the priority is emergency funding for the here and now. But we are forced to fortify our hospitals and rebuild them underground for our own safety. This is not development - this is protection.

As medics, we know that to properly heal, we must treat the cause and not only apply a band-aid solution. Supporting underground facilities is a band-aid to the much larger

issue of the systematic targeting of medical facilities by the Syrian government and its allies. **But these fortified and underground facilities are helping to protect our staff, save our patients, preserve critical donor-funded equipment, and prevent displacement.** This is what donor governments should prioritize as they work towards a political solution that will end the conflict for good.

We ask donors to listen to us, the Syrian medics who do this work day after day. We know how the Syrian government works. We know that systematically attacking hospitals is a tactic to break communities. We know that unless something dramatic changes politically, this tactic will continue to be used in Idlib, Hama, rural Aleppo, East Ghouta, Daraa, and other areas.

We have a narrow window to fortify medical facilities to save lives. We do not want to look back on this moment and wish that we had done more.

Signed:

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BACKGROUND: SYSTEMATIC ATTACKS ON HEALTH



“ EVIDENCE COLLECTED BY THE COMMISSION LEADS TO AN OVERWHELMING CONCLUSION: GOVERNMENT FORCES DENY MEDICAL CARE TO THOSE FROM OPPOSITION-CONTROLLED AND AFFILIATED AREAS AS A MATTER OF POLICY.”

UN Independent International Commission of Inquiry¹⁰

From the first days of the uprising in Syria, the Assad government has systematically targeted, denied, and weaponized healthcare.

On March 22, 2011, only a week into the peaceful demonstrations, regime forces seized the Daraa National Hospital, cleared it of non-essential staff, and positioned snipers on the roof, to ensure that only Assad supporters could enter the hospital.⁹ This was only the beginning.

The Assad government quickly began arresting wounded protesters in hospital emergency rooms and threatening the medical workers who treated them. Within the first few months of the uprising, government forces denied wounded civilians impartial medical treatment; invaded, attacked, and misused hospitals; impeded medical transportation; and detained and tortured doctors for treating wounded civilians.¹⁰ In 2011 alone, 250 physicians were arrested for treating protesters, in addition to tens of nurses and pharmacists.¹¹ “Counter-terror” laws issued in July 2012 officially criminalized the provision of medical aid to the opposition and

those perceived as opposition supporters, in direct violation of customary international humanitarian law.⁸ Providing medical treatment to “the other side” became punishable by death.⁹

Medical workers were forced to use houses, farms, warehouses, and other available buildings as makeshift medical centers to treat patients. As the conflict escalated in 2012, with the increased use of shelling and aerial attacks, physicians began to formally set up field hospitals, alternative medical facilities in opposition-held areas. Protective strategies and best practices emerged, such as the fortification of facilities and the separation of hospital wards across multiple buildings. Medical service provision for civilians in besieged areas became even more dire as the Assad government began a pattern of systematically removing medical assistance from the few aid convoys it allowed to enter besieged areas, taking out medicine, vaccinations, surgical equipment, and even baby formula. As the attack tactics against civilian areas evolved - particularly after the use of barrel



November 16, 2016 Central Blood Bank
Source: Melad Shihaby

bombs escalated in December 2013, and after the Russian intervention in October 2015 brought more advanced weaponry - the need for operationalized protection mechanisms for medical facilities increased.

The systematic attacks on health workers and facilities has driven the majority of medical professionals in Syria to flee the country, adding an additional burden on those who remain. By 2014, more than 15,000 doctors fled Syria - half of Syria's 30,000 physicians.¹² Now, there are only 1,070 physicians in opposition-controlled areas.⁵ Despite the severe shortages of medicine and supplies, the lack of trained medical personnel and specialists is the biggest challenge to healthcare provision.¹³

The second half of 2016 saw an unprecedented level of attacks on hospitals, demonstrating that the need for protection is only growing. Following the adoption of UNSC Resolution 2286, which condemns attacks against medical facilities and

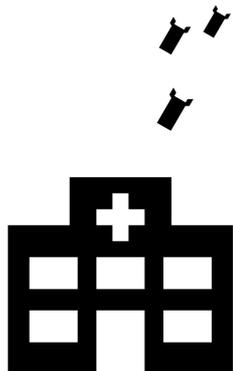
personnel in conflicts, the rate of attacks on healthcare increased by 89%.¹⁴ This has continued into 2017 - during April 2017 alone, there was an attack of a medical facility every 29 hours. Eleven facilities were destroyed or forced out of service in this month.²

The pattern of repeat attacks on individual hospitals indicates that they are intentionally targeted to deny healthcare to the civilian population in opposition-held areas. This is consistent with the Syrian government's strategy of forcing displacement through violence and suffering - without qualified doctors and medical facilities, thousands are forced to flee local communities. Hospitals in Kafr Zita, Hama, have been bombed 33 times since 2014, including at least six times in 2017 alone.³ In the recent Syria National Hospitals Study conducted by Syrian medics, all 107 hospitals surveyed across seven governorates were hit at least once by "direct or indirect airstrikes" in 2016 - some as many as 25 times.⁵ Targeted attacks on hospitals are a violation of international humanitarian law, the Geneva Conventions, numerous UN resolutions, and are a war crime. The scale of the systematic attacks against hospitals and healthcare in Syria is unprecedented in history.³

The targeting of hospitals has not only led to deaths from the attacks, but has also reduced the quality and availability of healthcare, and led to patients being too scared to seek medical attention at hospitals. The degraded health infrastructure coupled with this fear has led to a number of indirect deaths from preventable diseases, chronic diseases, and normally non-life-threatening injuries. Protective measures like underground facilities and reinforcements allow patients feel more secure when seeking medical treatment.

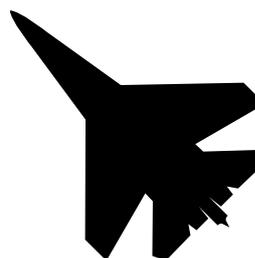
Now fortification of medical facilities is considered a basic standard for medical organizations supporting hospitals in Syria, and new underground facilities are designed and engineered to withstand attacks. Though the necessity of such extreme measures is costly, time-consuming, and often demoralizing for staff forced to work and live underground, these

fortified and underground facilities have saved the lives of countless patients and hospital workers. While at least 814³ health workers have been killed in Syria since the beginning of the conflict, no health workers have been killed from an attack while working in a fully underground hospital.⁴



454 HOSPITAL ATTACKS

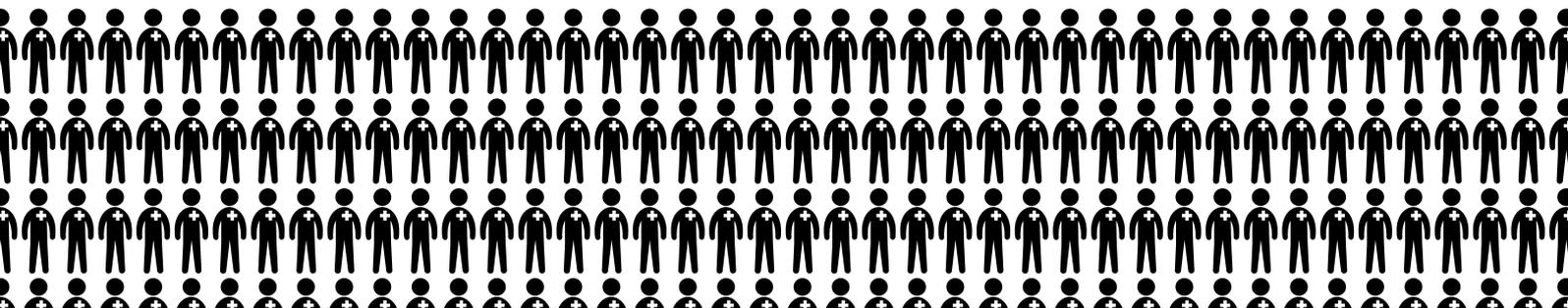
Between March 2011 - December 2016¹



**91% BY ASSAD REGIME
OR RUSSIAN FORCES¹**

814 HEALTH WORKERS KILLED

Between March 2011 - February 2017³



...THOUGH NO HEALTH WORKERS HAVE BEEN KILLED FROM AN ATTACK WHILE WORKING IN A FULLY UNDERGROUND HOSPITAL.⁴

HOSPITAL FORTIFICATION

HOW TO REDUCE DESTRUCTION AND CASUALTIES

Construction of an underground facility in Idlib
Source: Syrian American Medical Society

Relocating hospitals underground and fortifying operating hospitals is an extreme approach. Unfortunately, the context of systematic attacks on healthcare in Syria necessitates these extraordinary and unusual measures.

Various practices have been developed and implemented to ensure that protective measures are as effective as possible to withstand aerial attacks and aftershocks, as well as prevent death and injury from the collapse of structures, broken glass, shrapnel, and debris. Threat reduction and protective design is a very complex and specialized field. Each facility must engage an experienced technical team to evaluate and produce the most optimal design given the available options.

BUILDING SELECTION AND SACRIFICIAL FLOORS

Taller buildings offer more protective capabilities than shorter ones due to their sheer mass, heavier framing, and the presence of additional top floors that are not in use. These floors are abandoned and act to absorb and slow down the blow of an aerial attack. When budgets permit, additional protection - such as mattresses, styrofoam, or sandbags - is added between floors to further cushion the impact, distribute the damage, and prevent overloading any structural element of the building frame.

STRENGTHENING OF THE BUILDING FRAME

When buildings are attacked, columns, beams, and wall elements are overstressed and can buckle and crush. The entire building can collapse, becoming a pile of rubble and killing its occupants. Strengthening framing elements to carry extra

loads is a critical aspect to fortification - though it is very costly and requires detailed construction techniques.

SANDBAGS AND EXTERNAL WALLS

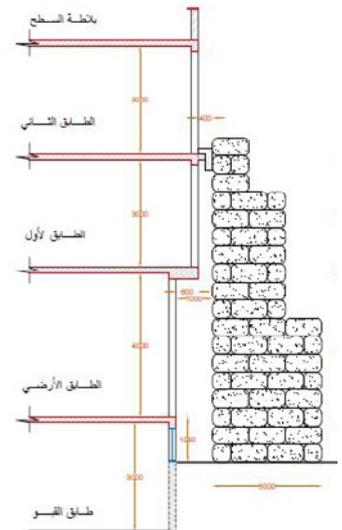
The facility's sides must be reinforced with concrete or masonry walls and barriers, adding protection from the impact of shelling and aerial attacks. There will ideally be a full-height concrete wall around the facility.

Some facilities use sandbags or barrels

of sand for reinforcements. Height, width, and distribution of protective walls require a detailed review of the site and must take into account the building location, access requirements, and impact on adjacent structures.

WINDOWS AND GLAZING

Glass and shattered windows can be responsible for a large number of injuries during attacks. The glass panes in most facility windows are eliminated to prevent potential projectile shards hurting people during a bombing. The remaining glass windows are laminated or shatter-proofed. Duct tape or plywood is layered over the window. In basements, windows are eliminated or filled in with sandbags, grouted masonry, or reinforced concrete.



Protective wall engineering plan

BASEMENTS

There should be at least one basement level - two or more is ideal. Strips of rubber or carbon fiber sheets can be applied to masonry walls so they don't shatter, or in the case that they do, so they don't disperse and become harmful projectiles. Artificial ceilings are often created for certain hospital departments - medics have discussed how plastic or foam ceilings are best for operating rooms, as there will be less dust or debris in an attack.



A hospital set up in a basement, Aleppo
Source: Syrian American Medical Society (SAMS)

SURROUNDING BUILDINGS

Buildings selected to serve as hospitals should be considered based on a detailed evaluation of their proximity to adjacent buildings. Building shape, location, orientation, access, and exit plans are a few of the criteria that must be considered to prevent an attack on one building causing progressive collapse and damaging multiple buildings.

ELECTRIC GENERATORS AND FUEL TANKS

Most medical facilities in Syria entirely run off of generators, making them an invaluable aspect of each hospital. Generators are typically housed in a separate building or shop near the hospital - they are above the ground but must also be protected with fortified enclosures to ensure their availability after an attack. Diesel fuel tanks are equally important and are protected in similar ways.

WATER SOURCES

Most medical facilities in Syria entirely use water delivered by trucks and kept in storage tanks and sometimes wells. Like diesel fuel tanks, they must also be protected with fortified enclosures to ensure their availability after an attack for washing, cleaning, and in the case of a chemical attack, decontamination. Water purification equipment is essential for surgical and medical procedures like dialysis and must also be protected to ensure continuous operation.

PERIMETER SECURITY

Protective measures must control traffic patterns around the building. Emergency vehicles must have adequate and dedicated access to ER entrances.

PARKING

Ambulances, which are often identified by warplanes and targeted, should not park outside of the facility. Parking for ambulances must be reserved in a covered and fortified zone. This contributes to the protection of the location of the facility, as well as the preservation of the ambulances.



Ambulance parking under construction in an underground facility in Idlib. Source: Syrian American Medical Society (SAMS)

ENTRANCE AND EXIT

These are important safety features to prevent destruction from shockwaves after an attack. The entrance and exit into an underground facility must be well thought out - they should be laid out to minimize the shockwave propagation, such as using tunnels with zigzags. Diffusing the impact of shock and allowing dissipation will limit damage and help prevent loss of life. Entrances and exits should be equipped with high quality metal double doors along with quality construction.

VENTILATION

An advanced ventilation system is especially important in medical facilities, securing clean air and exhausting contaminated air out. Vent size, quantity, and location is selected by the facility engineer to minimize potential for contamination and spreading of chemical agents, dust and debris. Filtration systems are typically employed in elevated locations to secure circulation for the selected building. Underground facilities have very challenging HVAC (heating, ventilation, air

conditioning) considerations to overcome while serving multiple functions including lighting, blow out venting, and a number of other engineering considerations. A detailed mechanical engineering design is required to provide adequate ventilation while simultaneously limiting the spreading and contamination effects of a chemical agent threat.



A cave hospital ventilation shaft
Source: IHH Humanitarian Relief Foundation

TYPES OF UNDERGROUND HOSPITALS

There are currently three major models used to safeguard medical facilities in Syria: a basement component of an existing structure, a cave hospital, or a completely underground structure. The model chosen depends on a number of factors, including environment, price, threats, existing structures, and resources available.

HOW TO CHOOSE THE LOCATION OF AN UNDERGROUND FACILITY

A

LOCAL NEEDS

Local medical authorities conduct needs assessments to determine the shortages in medical assistance and needs of medical facilities in their area.

B

GEOLOGICAL FEATURES

Local public works engineering groups survey available site options to benefit from existing geological features of the area that would assist in creating an underground facility. Areas with previously drilled or cut rock, or rock quarries, make for useful terrain to save costs and speed construction. Flat terrain adds to the challenges of constructing an underground medical facility and increases the budget substantially. Ramps, ventilation, and a number of other logistical considerations have to be taken into account in the layout and functional design.

C

ACCESSIBILITY

For major hospitals, which treat the majority of trauma victims and need to be easily reachable by ambulance, the facility must be accessible via the main highways. It is recommended to provide ground level access straight from a highway into a protected and covered area. This can greatly facilitate safe and expedient delivery of patients to medical staff for immediate attention.

1. BASEMENT HOSPITAL

“ YOU IDEALLY DON’T WANT TO BUILD A NEW BASEMENT. THERE ARE A LOT OF BASEMENTS THAT YOU CAN BUY OR RENT. YOU CAN DO SOME RENOVATION ON A BASEMENT TO BE A FORTIFIED MEDICAL CLINIC OR HOSPITAL.”

Dr. Abdulkhalek, Ophthalmologist
Al Hayat (M3) Hospital, East Aleppo

Most frequently, the basement of an existing building is fortified and used as an underground medical facility to lessen the impact of an attack. Instead of constructing a new building, a vacant building with a basement - a school, factory, or shop - is rehabilitated and turned into a hospital. At least 71 hospitals in Syria, approximately 66% of all hospitals in opposition-held areas, use basements for major medical services.⁵ This model ideally includes a number of above-ground floors to increase protection. The floors above ground are reinforced using sand and concrete. This is the easiest and least expensive model, as it uses an existing structure as a base. However, it is the most vulnerable from a protection and threat-reduction standpoint.

EXAMPLE: SAMS’s Al Sakhour Hospital, known as M10, in East Aleppo, was constructed using this model. No lives were lost inside M10 during its time of operation after fortification.

AVERAGE COST: \$80,000 - \$175,000 for standard rehabilitation and fortification; up to \$1 million for rehabilitation and fortification of more expansive facilities.



Source: Syrian American Medical Society (SAMS)

2. CAVE HOSPITAL

“ WE HAVE NOT LOST ANYONE IN THE CAVE HOSPITAL, STAFF OR PATIENTS, THANKS TO THE FORTIFICATIONS, UNLIKE THE OTHER HOSPITALS ACROSS SYRIA.”

Dr. Mohammad Bakour, Medical Director
Central Cave Hospital

The more effective protective model is the cave hospital, in which medical facilities are built into caves carved into the side of a mountain. This model provides reasonable protective measures, but has limited feasibility as it can only be constructed in environments that contain mountains. It requires securing the entrance to the hospital, creating an emergency exit, and ensuring ventilation, but is a comparatively inexpensive model as it relies on the existing base structure of the mountain. This model has proven to be effective when designed properly and laid out with attention to details.

EXAMPLE: The largest cave hospital in Syria is the Central Cave Hospital, pictured, which is 500 - 600 meters large, contains three operating rooms, and houses a range of services.

AVERAGE COST: \$200,000 - \$800,000



Source: Khalil Ashawi, Reuters

3. UNDERGROUND HOSPITAL

“ **THE HOSPITAL I WORK IN MOST FREQUENTLY IS BUILT UNDERGROUND AND IS EXPOSED TO AN AIRSTRIKE EVERY FEW DAYS. THANKFULLY, WE HAVE HAD NO DEATHS OR INJURIES AMONG THE STAFF.**”

The other hospital I work in is in a normal building, and has been targeted with more than 30 airstrikes so far. Nearly 30 people have been killed in the hospital during the raids, including doctors and nurses.”

Dr. Jaber, physician at two hospitals in Idlib
(unnamed for security)

The final and most expensive model requires building a new, completely underground facility. A hospital is built several meters below the surface, has a thick, reinforced concrete frame, and is covered by protective ground backfill to create the additional layer of safety. The advantage of this model is that it can be replicated anywhere with few modifications because of its standard design. However, as it involves the construction of a completely new structure, it is the most expensive model and requires the longest time to completion.

EXAMPLE: There is a major underground hospital in rural Hama (name and location withheld for security). After the original above-ground facility suffered several direct bombings and was destroyed in an airstrike, the hospital was rebuilt completely underground. It serves residents and internally displaced persons (IDPs) throughout the Hama countryside and southern and eastern Idlib. It houses surgical and orthopedic operating rooms and treats 1,300 cases a month.

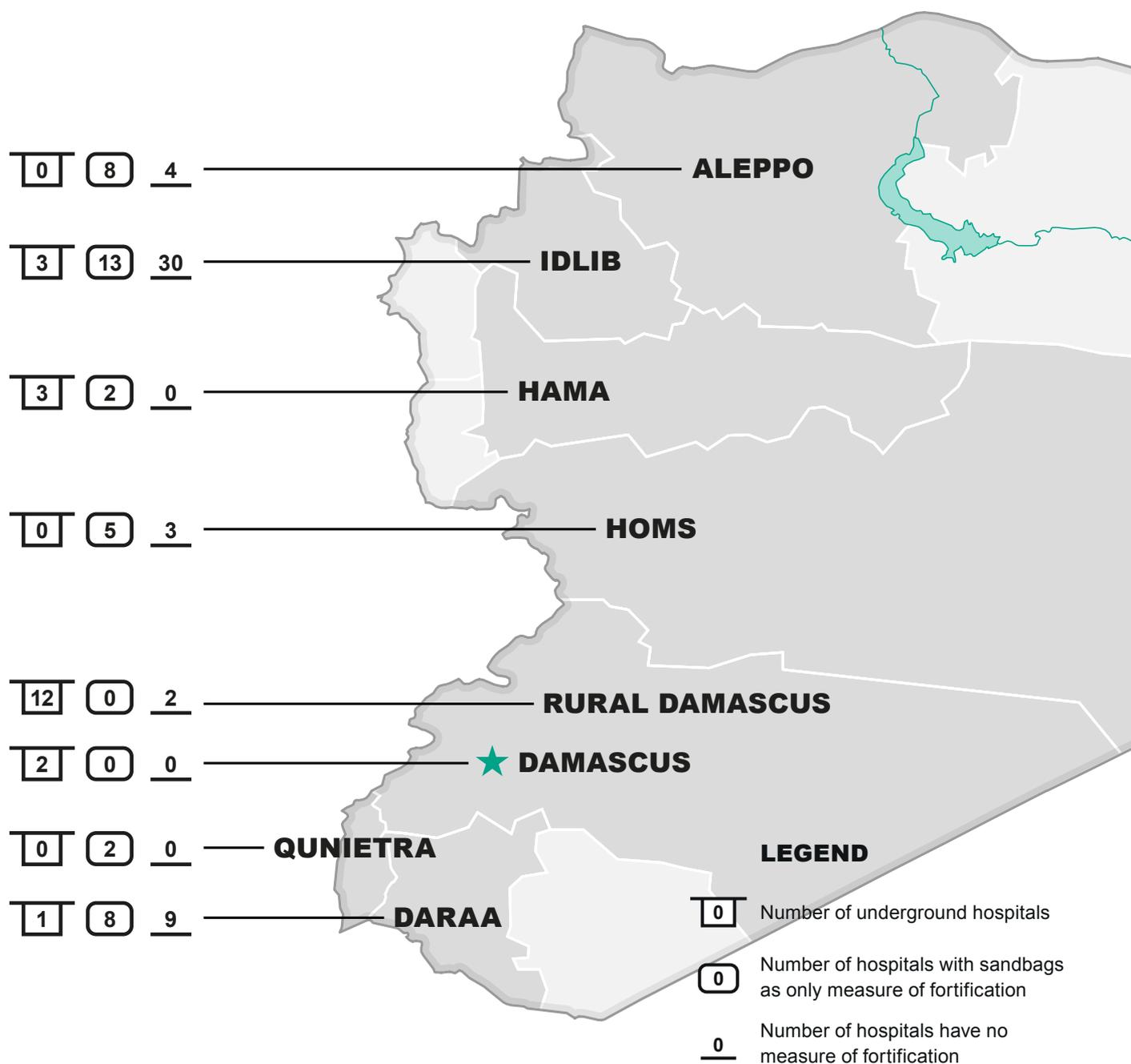
AVERAGE COST: \$800,000 - \$1.5 million

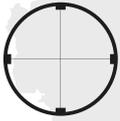


UNDERGROUND HOSPITALS ACROSS SYRIA

FORTIFICATION BY GOVERNORATE⁵

- 21 underground hospitals (20%)
- 71 hospitals use basements for major medical services (66%)
- 38 hospitals have sandbags as only measure of fortification (36%)
- 48 have no measure of fortification (47%)
- 4 cave hospitals (4%)





HAMA: CENTRAL CAVE HOSPITAL

“ WE ARE NOT FEARFUL IN THE CAVE, IN THE SAME WAY WE WERE IN THE OTHER HOSPITALS.”

Dr. Mohammad Bakour, Medical Director
Central Cave Hospital

After mass aerial attacks on hospitals in the Hama countryside in 2014, local medics decided to build a hospital in a cave in the town of Kafr Zita. Dr. Hasan Al-Araj and Dr. Abdullah Darweesh initiated the Central Cave Hospital, which lies under more than 20 meters of pure rock. The hospital provides all medical treatment free of charge.

It took one year to build and fortify. The facility is between 500 - 600 square meters in size, and provides a range of specialty services, including an orthopedic unit and gynecology services. It serves around 200,000 residents and internally displaced people (IDPs), conducting more than 160 operations and treating 3,000 patients per month.¹⁵

The Central Cave Hospital became operational in September 2015 - at the same time that Russia's direct military intervention started in Syria, when attacks on hospitals escalated and more advanced weaponry was deployed by Syrian government and Russian aircraft. Hospitals in Kafr Zita, Hama, have been bombed 33 times since 2014³ and the Central Cave Hospital has sustained three direct hits on the facility. No one has been killed inside the facility - staff or patients - due to the fortifications.



Source: Zaher Sahloul

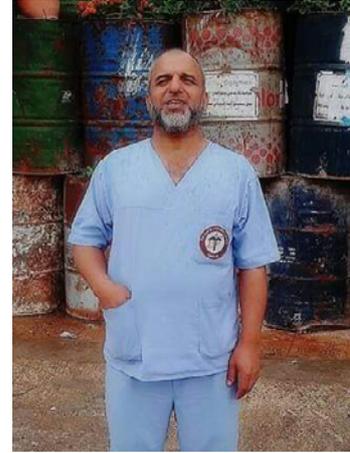


EAST ALEPPO: AL SAKHOUR (M10) HOSPITAL

“ **WORK AND LIFE UNDERGROUND FELT SAFE, EVEN DURING THE BOMBINGS.**”

We felt safe because of the protections. We just made sure to remain downstairs, and the fortifications allowed the staff to continue doing their work, and for the patients to feel safer in the facility.”

Dr. Mohamad Abu Rajab, Radiologist
Al Sakhour (M10) Hospital, East Aleppo



Al Sakhour Hospital, known as M10 and supported by the Syrian American Medical Society (SAMS), was the largest trauma facility in East Aleppo until it was bombed out of operation in October 2016. M10 was established in February 2013 to service the northern part of East Aleppo, which did not have a trauma center.

As the use of barrel bombs increased towards the end of 2013, the need to move the hospital underground was quickly recognized. The fortification process began in February 2014 and lasted for six months. Tunnels were dug to connect underground components of buildings. For safety reasons, the staff dorms were the first to be moved underground, followed by the Intensive Care Unit (ICU) and trauma capacities. The hospital's three above-ground floors remained solely for protection and were no longer used for hospital services. The building was also fortified with sandbags, barrels filled with sand, and thick cement walls.

The hospital, as the largest surgical center in East Aleppo, provided the majority of large operations. By August 2015, it housed the sole CAT scan in the area. M10 had around 90 staff, and held 300 consultations per day and 300 surgeries per month.



During its time of operation from February 2013 until October 2016, M10 was bombed 22 times. During the siege of East Aleppo in the latter half of 2016, aerial attacks against M10 dramatically escalated. It was hit repeatedly with a variety of weapons, including incendiary weapons, cluster munitions, air to surface missiles, bunker buster bombs, and vacuum missiles. In October 2016, M10 was targeted five times in one week. In the fifth attack, a bunker buster hit directly outside of the hospital's entrance, killing three maintenance workers who were working to restore it, and further damaging its infrastructure. Less than two weeks later, the hospital was hit again. For the security of staff, and with the targeted attacks occurring faster than staff's ability to reconstruct the damaged hospital, the decision was made to close the hospital permanently on October 14.



The only CAT scan in East Aleppo, in the M10 hospital.
Source: Zaher Sahloul

“ ALEPPO WAS PLAGUED WITH BARREL BOMBS. IT WAS VERY UNSAFE TO TRAVEL AROUND THE CITY.

Often we would get to M10 going from one hospital to another and we all felt relieved when we got there, as it felt much safer than the overground hospitals. We could hear gunfire and helicopters all the time, and a barrel bomb did hit M10 when we were there, but we all survived.”

Dr. David Nott, vascular surgeon who has worked in Aleppo and Idlib

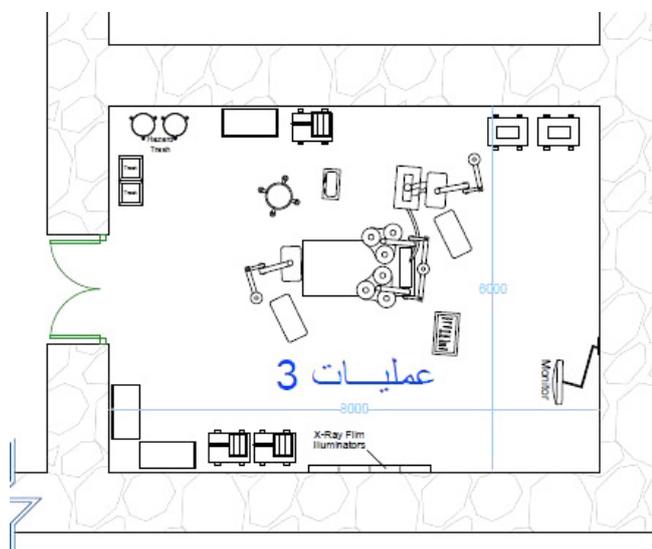


IDLIB: AVICENNA NATIONAL HOSPITAL

The largest hospital in Idlib is currently in its final construction stages in Idlib City - the new Avicenna National Hospital. This will be a referral hospital, where the majority of critical trauma cases in the surrounding areas in Idlib and Hama will be referred.

Its specializations and advanced services - particularly specialized services for women and children - will help other first-line hospitals avoid being overloaded with cases. It will also decrease the number of critical cases that need to be referred to specialized medical facilities in Turkey, which is particularly important because of the tightened Turkish-Syrian border. While beneficiary numbers for this new facility are hard to predict, Bab Al Hawa Hospital, which is comparable in size and scale, treats between 4,000 to 5,000 cases per month.

The hospital has eight empty floors above ground, which act as a shield for the facility, and the weak points of the hospital are strengthened by different materials, including one to two meters of cement and iron. The two operational levels will be underground. One level will include an elective theater department, emergency operations department, surgical and non-surgical ICU, and an ER department. The second level will house the Avicenna Women and Children's Hospital, which will provide specialized maternal and child health services, with a small department for internal medicine. There are very few advanced services for women and children in Idlib, making this hospital critical for reproductive health. The Avicenna National Hospital will have 14 operation theaters.



Engineering design of an underground operating room. Source: Syrian engineering group.

Over 330 medical staff will be working at the hospital, on a shift system designed to provide them with breaks to avoid burn out. Hospital coordinators are working to ensure that staff will not need to remain in the hospital for more than 24 hours, which has become a norm among medics in opposition-controlled Syria. There will also be a medical training facility associated with the hospital, to train new nurses and midwives, and to help medical professionals gain new specialized skills. In Syria, the majority of pregnant women opt to have cesarean sections to give birth, to avoid spending unnecessary time in hospitals - the educational facility at Avicenna will provide surgeons and other medical staff with c-section trainings to meet this growing need. Hospital coordinators are also working with Brown University to launch a major tele-medicine program to help train medical staff and assist with technical support, daily medical consultations, and weekly reviews.

Unlike many other facilities, the Idlib Health Directorate and hospital coordinators are not attempting to hide the hospital's location. Khaled Almilaji, Chair of the Sustainable International Medical Relief Organization (SIMRO), said of the hospital, "We cannot hide a referral hospital because of its size. We need another approach. We must secure it, but we also want to make the humanitarian operations completely transparent, so that if there is an attack, Russia and the Syrian government cannot claim that this is not a recognized hospital."



Construction of the Avicenna National Hospital. Source: Khaled Almilaji



RURAL DAMASCUS: EAST GHOUTA HOSPITAL

“ I BELIEVE THE UNDERGROUND FACILITIES ARE SAVING LIVES OF PATIENTS AND STAFF COMPARED TO ABOVE-GROUND FACILITIES.

One time when we were in our hospital in the basement, the surrounding area was targeted by 14 airstrikes. Our operations on the injured patients continued in the basement. Without the basement, we couldn't operate. It gives relative comfort to surgeons, medical staff, and their patients in the ER.”

Dr. Abou Yaser, Hospital Manager
hospital in East Ghouta (unnamed for security)

In the besieged areas of Syria, health services have all but collapsed. The makeshift field hospitals in East Ghouta are incredibly under-resourced and understaffed. Thirteen of the 14 major hospitals in besieged East Ghouta use basements for major medical services.⁵ One example is a hospital serving the population of a rural town in East Ghouta. The facility is underground, in a basement. Sandbags and fortified panels reinforce the hospital, layered around the perimeter of the hospital five meters high. The hospital has been targeted and struck numerous times by aerial attacks, and was completely destroyed by a barrel bomb in 2015. It was then rebuilt in a different location. The biggest obstacle to additional protective measures has been financial resources.

The hospital treats about 6,000 patients per month. It houses several specialized services, including an ER department, X-ray department, analytical laboratory, dental facility, and three operating rooms for various types of surgeries. It also has an obstetrics and gynecology center, supporting pregnant women with maternal and child health services, cesarean sections, and complex surgeries. Staff work in the hospital nearly 24 hours a day out of necessity.

One of the greatest losses that the hospital suffered was when two doctors were killed in the entrance of the hospital. Dr. Abou Yaser, the hospital manager, recalled:

“ ONE DAY, TWO OF OUR GREAT DOCTORS WERE IN THE HOSPITAL - DR. YASSER, AN EMERGENCY SURGERY SPECIALIST, AND DR. NOUR, GENERAL SURGERY RESIDENT.

They used to treat the patients in the basement, and sleep there. But this night, the doctors slept on the first floor after a long night of work. It was the first day of Eid Al-Fitr, and as usual, the regime targeted the area that morning, holiday or not. A shell hit the first floor of the hospital, where the doctors were sleeping, and they were killed instantly. Their losses meant a lot for us in East Ghouta.”

Dr. Abou Yaser, Hospital Manager
hospital in East Ghouta (unnamed for security)



The last 2 ambulances in one besieged town in East Ghouta were destroyed in an aerial attack in December 2016. Source: Médecins Sans Frontières (MSF)



DARAA: AL-REDWAN FIELD HOSPITAL

“ WE FEEL SAFER IN THE FACILITY NOW THAT IT IS UNDERGROUND, AND SO DO THE PATIENTS.”

Dr. Ihab Abo Al Hakam, Facility Manager
Al-Redwan Field Hospital

The Al-Redwan Field Hospital was established in February 2013, initially housed in a local school. On May 15, 2014, the makeshift hospital was targeted by a Syrian government airstrike, killing a doctor, lab technician, radio technician, and two nurses. As a result, the hospital was moved to a new building.

There were repeated airstrikes near the hospital's new location. On July 31, 2016, Russian or Syrian government warplanes launched four vacuum missiles onto the residential neighborhood near the hospital. The hospital was hit directly by an airstrike, killing nine people, including a laboratory technician, a pharmacist, and seven patients - two of them children - and injuring 21 others. After this attack, the medical team decided it was necessary to fortify the hospital.

The fortification process occurred between August and November 2016. The hospital has a basement and two floors above ground. The perimeter of the basement and the two floors are completely covered with soil and sand. Trees were planted on the sides of the hospital to enhance the stability of the soil. The hospital is ventilated through pipes, with the dual purpose of allowing light to enter the hospital, and styrofoam layers the walls.

After moving underground, the facility saw an increase in employment of doctors and staff because they felt safer.

The Al-Redwan field hospital treats more than 4,500 patients per month. It provides primary health care and houses a range of services, including an emergency room, maternity department, operations department, inpatient services department, and intensive care unit.

COPING WITH ATTACKS



November 18, 2016 Central Blood Bank
Source: Melad Shihaby

While attacks against medical facilities have become the horrific norm in Syria, there are particular types of weaponry that pose an even more intense threat to the physical safety of health workers and civilians. Bunker buster bombs, which can destroy underground shelters, and chemical weapons attacks are particularly dangerous for people underground.

In addition to fortifying facilities, medics and rescue workers have developed early warning systems for attacks and emergency response plans and protocols for various types of attacks. While no medical staff have been killed in the underground components of hospitals from airstrikes, several have been killed in the entranceways of hospitals, underlining the importance of early warning systems. This section looks at how hospital staff cope with bunker busters and chemical attacks, and one example of a creative early warning mechanism saving lives.



A nurse saves a dove from under rubble after the Arbin field hospital is destroyed on May 1, 2017. Source: Sameer Al Doumy

BUNKER BUSTER BOMBS

“ IN OCTOBER 2016, THERE WAS A MAJOR INCIDENT WHERE THE CAVE HOSPITAL WAS TARGETED BY TWO BUNKER BUSTER BOMBS.

Right afterwards we were targeted by cluster munitions. A few hours later, the warplanes returned with 4 air raids, bombing to anticipate people leaving their shelters. This was probably the most violent attack the cave sustained. We went out of operation for security, but thankfully the operation rooms and other essential facilities were not damaged. The bunker busters damaged sections near the entrance of the cave. Despite the sheer danger and abilities of these bombs, we were able to rebuild and return to operation in a few days. That is a testament to the staff's resilience.”

Dr. Mohammad Bakour, Medical Director
Central Cave Hospital

Bunker busters, or BETAB-500 bombs, are munitions designed to penetrate below the ground before detonating, able to destroy entire buildings and underground shelters. The Syrian Air Force and Russian jets have both used these weapons in Syria, and began using bunker busters in urban, residential areas of East Aleppo in the fall of 2016.⁷

While underground hospitals provide security from most aerial attacks, when bunker busters began targeting hospitals, they made it so that medics and patients had nowhere to hide. Intensive fortification, such as with highly secured cave and underground structures, have been the only measures to protect against the complete destructive power of bunker busters. Even in highly fortified facilities, the degree of damage and destruction depends on the intensity and specificity of the attack. Particularly as the use of bunker busters increases, and as they target highly fortified medical facilities, it is of the utmost importance that fortification is done with an experienced technical engineering team, and that engineering studies and recommendations are followed carefully on a case by case basis.

CHEMICAL ATTACKS

“ STAFF FEEL MORE SAFE UNDERGROUND. BUT AFTER BUNKER BUSTERS BEGAN, THE STAFF FELT WORRIED. WHEN THEY COULDN'T DESTROY US WITH BUNKER BUSTERS, THEY SMOKED US OUT WITH CHEMICAL ATTACKS.”

Dr. Farida, OB/GYN at Omar bin Abdulaziz
(M2) Hospital, East Aleppo

There have been more than 180 chemical attacks in Syria since the beginning of the conflict.¹⁶ Because chemical gas is heavier than air and sinks to lower areas, chemical attacks are particularly harmful and challenging for patients and staff in underground hospitals. It is critical that underground facilities include adequate ventilation in order to mitigate the effects of chemical gases.

During the siege of East Aleppo, there were at least eight chemical attacks on the besieged city in one month.¹⁷ Dr. Abdulkhalek, an ophthalmologist at the Al Hayat (M3) Hospital, said of the attacks, “Most of the victims were children, and we only had one unit of oxygen. The medical staff worked tirelessly to try and pass the mask from one child to another, so that they wouldn't suffocate. These chlorine attacks occurred after repeated attempts by the regime and its allies to destroy the hospital using barrel bombs and cluster munitions had failed. Instead, they resorted to chemical attacks to drive us out.”¹⁸



Child being treated after a chlorine attack on Aleppo on November 18, 2016. Source: Independent Doctors Association

One heartbreaking example stands out in portraying the danger that chemical attacks pose to medical personnel in underground facilities. On March 25, 2017, barrel bombs containing a chemical agent were dropped at the entrance of the underground Latamnah Hospital in Hama and gas entered the hospital, causing intense respiratory and neurological injuries to medical staff.¹⁹ The hospital, built into the side of a mountain, did not have a strong ventilation system to prevent the spread of gas throughout the facility, or enough oxygen to handle the large amount of patients and staff with breathing trouble. Dr. Ali Darwish, an orthopedic surgeon, was operating on a patient and refused to leave his side, continuing to operate until he lost consciousness. He died from prolonged exposure to the chemical agent.



Dr. Ali Darwish

Chlorine and sarin gas have been used by the Syrian government against civilians as recently as April 2017. These ongoing chemical attacks in Syria are grave violations of international humanitarian law, the Chemical Weapons Convention, and numerous UN resolutions. Similar to the strategy of attacks on healthcare, the use of chemical weapons is part of a strategy to displace Syrians in opposition-controlled territories.

“ CAN YOU IMAGINE CHEMICAL ATTACK VICTIMS IN THE BASEMENTS, WITHOUT AIR CIRCULATION? [DURING THE AUGUST 21, 2013 SARIN ATTACK] I HAD TO EVACUATE THE STAFF SEVERAL TIMES TO LEAVE THE HOSPITAL FOR 30 MINUTES TO GO AND BREATHE AFTER WE STARTED TO ALSO GET POISONED.”

Dr. Khalil Al Asmar, cardiologist and former manager of the United Medical Office of Douma

THE CUTEST EARLY WARNING SYSTEM



Source: Amjad Rass

THIS IS ROCKY.

Rocky is the beloved dog of the staff from the Central Cave Hospital in Hama, who also doubles as a life-saving early warning system. Medics have trained Rocky to respond to the sounds of warplanes. When he hears a warplane, he barks and runs inside, alerting the staff to take cover in the facility.

This is one creative type of early warning system. Medical teams also use walkie-talkies alongside the Syrian Civil Defense and others for “spotter networks,” networks of communication to alert communities to take cover when warplanes are approaching and allow medics to prepare themselves for the immediate aftermath of an attack.²⁰ While no staff have been killed from attacks in fully underground hospitals, several have been killed in the entranceways of underground and above-ground facilities - early warning systems are critical to alert all staff to take cover.

PROTECTING BABIES IN BASEMENTS

“ **WORKING UNDERGROUND IS DEFINITELY SAFER THAN WORKING ABOVE GROUND. IT HELPS PROTECT INFANTS IN THE VERY VULNERABLE INCUBATOR SECTION IN PARTICULAR.**”

Last year, four attacks happened on the Children’s Hospital, and we moved downstairs after the second attack in mid-2016. Before, we had lost people because we were working on the first floor. It was during one of those airstrikes that four of our baby patients died. When we started working in the basement, we stopped losing anyone among our patients or the staff.

It is very important to make the hospitals underground, but we should stop the reason that forces us to work underground. Eventually, the regime or Russia could create a new weapon to reach us underground. The most important thing, as it is for all hospitals in the world, is to allow us the freedom and safety to work above ground.”

Dr. Hatem, former Director of the Aleppo’s Children’s Hospital and current Director of the Hope Hospital for Children



Babies in incubators in the basement of the Aleppo Children’s Hospital. Source: Independent Doctors Association

AN INNOVATOR

DR. HASAN AL-ARAJ

1970 – 2016



“ DR. HASAN AL-ARAJ WAS A BROTHER TO ME. WE ARE FROM THE SAME GENERATION, GREW UP AS CLASSMATES, ALL THE WAY THROUGH MEDICAL SCHOOL.

We became humanitarian doctors during the conflict together, establishing the Central Cave Hospital together, establishing the Hama Health Directorate together, living and eating together, and seeing more of each other than we saw of our spouses. May he rest in peace. He meant a great deal to me and to everyone around us. His wisdom and bravery allowed for medical services to reach the people in this area. He was an example to me and to all of us, and we try to carry on his legacy.”

Dr. Abdullah Darweesh, Central Cave Hospital, Hama

“ He was a brave man, and loved by all. He had a charisma. A leader by every sense of the word. Surgical work, activism, administrative work, he did it all, with endless energy. He treated all with respect. He had a famous line: “If you die, die standing for something, rather than sitting.” When he would visit his family in Turkey, after a few days, he would tell us he misses being back in Kafr Zita, despite the bombardment and dangerous conditions of war. The most he would stay away was for five days.”

Dr. Mohammad Bakour, Medical Director, Central Cave Hospital, Hama

“ Dr. Hasan offered everything he had for the Syrian people. Initially he lost his professional future as a physician, lost his own private hospital and clinic, lost a lot of his own money, lost his security and stability beside his lovely family, and at the end he lost his own life to save the lives of others.”

Dr. Mazen Kewara, Turkey Country Director, Syrian American Medical Society

“ Dr. Al-Araj told me about his dreams of making the hospital a museum after the crisis to show the world the extreme challenges through which Syrian doctors had to work in order to provide healthcare to their communities. He did not live to see his dream. We all miss his energy and smile.”

Dr. Zaher Sahloul, Past President, Syrian American Medical Society

Dr. Hasan Al-Araj is one of many Syrian medics whose innovation and dedication has saved countless lives. He was the last cardiologist in Hama, co-founder of the Hama Health Directorate, co-founder of the innovative Central Cave Hospital, and brother to the medical staff around him. He is a pioneer in creating underground facilities to protect his fellow medics and the patients they treat.



Dr. Hasan Al-Araj (center in red shirt) alongside medical colleagues from SAMS in his Central Cave Hospital.

Dr. Hasan owned the Kafr Zita Speciality Hospital, a private hospital in his hometown in Hama. When the revolution began, he treated protesters and victims of the early regime violence. As security forces sought out protesters, he prevented them from entering the operating rooms. When hospitals became increasingly unsafe for recovering protesters, Dr. Hasan even treated them in his home. In 2014, after airstrikes attacks on Kafr Zita escalated, Dr. Hasan initiated the building of the Central Cave Hospital, an innovative hospital that has changed the landscape of protection measures for health facilities in Syria.

Dr. Hasan was known by his colleagues and friends for his compassion and dedication to serving his community. Dr. Hasan's hospitals, both the Kafr Zita Speciality Hospital and later the Central Cave Hospital, provided free medical treatment for everyone. His wife Najwa and five children resided in Turkey for their safety as the security situation in Hama deteriorated, and Dr. Hasan would visit them frequently.

On April 13, 2016, Dr. Hasan left the Central Cave Hospital to go on his rounds. As he left the hospital, a missile targeted the ambulance he drove. Rescue workers found parts of his body and his white medical coat in the ambulance remains. He was 46 years old.



Dr. Hasan Al-Araj, former Hama Health Director and Co-Founder of Central Cave Hospital (1970-2016)

NEEDS FROM THE GROUND

“ THE PROTECTION OF MEDICAL STAFF, ESPECIALLY UNDER SIEGE, IS THE HIGHEST PRIORITY. WORKING UNDERGROUND IS VERY BENEFICIAL. EVEN PATIENTS FEEL SECURE THERE. HOWEVER, POOR FUNDING FOR THIS WORK IS OUR KEY OBSTACLE TO SUCH REINFORCEMENTS.”

Dr. Abou Yaser, Hospital Manager
hospital in East Ghouta (unnamed for security)

In order to truly protect medical staff and civilians, the systematic attacks on hospitals must be prevented. However, as attacks continue to escalate, resources for underground and fortified hospitals is the priority request made by Syrian medical groups of donor governments.

In November 2016, the Strategic Advisory Group for the Turkey-based Health Cluster, which includes the World Health Organization; Aleppo, Hama, and Idlib Health Directorates; and several Syrian medical organizations, made official recommendations on the key strategies for “protection of health staff and patients.” The top two recommendations were:

- 1. Fortification of existing hospitals under technical guidance from specialized engineers in fortification of infrastructures.**
- 2. Construction of self-contained underground fortified hospitals of not more than twenty beds.**

When creating the official health priorities for the UN Humanitarian Pooled Fund (HPF) funding allocation, the Health & Nutrition Clusters included as one of their top five priorities:

Rehabilitation, fortification and provision of supplies of key health infrastructures as well as the provision of supplies in hard to reach areas to be able to provide an essential package of services.

There is a particular focus for the HPF in rehabilitating and reinforcing health facilities in besieged and hard-to-reach areas. The HPF is one of the few funding mechanisms that provides funds for the fortification and construction of physical structures. The priority areas for fortification include specific districts in Rural Damascus, Homs, Idlib, Aleppo, and Hama.

The priority areas are locations where there are significant direct attacks from Syrian government and Russian warplanes. Idlib is one of the most critical areas in need of additional medical facility fortification and underground hospital construction. Since August 2016, the Assad government has forcibly displaced 10 formerly-besieged communities into Idlib.²¹ East Aleppo is the most prominent illustration of the Assad government's strategy in which it besieges an area, bombs and starves it into submission, coerces a "settlement," and transfers the population in whole or in part to Idlib. More than half of the Idlib governorate's population are internally displaced people, with the population continuing to grow.²² Many believe that the Syrian government will ultimately conduct a full-fledged military onslaught against the people of Idlib under the pretext of attacking terrorist groups, making the fortification of medical facilities an urgent need. In a plan outlined by the Idlib Health Directorate, it costs only **\$718,895 to refortify existing top priority hospitals.**

It has become clear through the patterns of weaponry deployed in specific locations that the Syrian government and Russia are increasingly using bunker busters and chemical weapons to target the most fortified medical facilities. Dr. Abdolsalam Daif, the Turkey Country Director of Syria Relief and Development, said, "The regime is changing their strategy according to our strategy. They and Russia are using different kinds of weapons depending on what protective measures we have on the ground." Dr. Khaled Almilaji, Chair of the Sustainable International Medical Relief Organization (SIMRO), reiterated that point, saying, "Whatever level of fortification or protection we have, it has become a game to Russia and the regime. We will see what you can build, and we will see if we can destroy it. We need a mechanism to convince Russia not to attack health

facilities, because their weapons are much more accurate and destructive.” While this underscores the ultimate need for the lasting political solution to the conflict and an end to attacks on civilian infrastructure, it also reinforces the importance of prioritizing the recommendations and detail-oriented implementation of experienced technical engineering teams when engaging in the rehabilitation of hospitals.

“ WE ARE NOT 100% PROTECTED UNDERGROUND, BUT WE ARE SAFER.”

Dr. Khalil Al Asmar, cardiologist and former manager of the United Medical Office of Douma



Medics struggle to save a patient in Rural Damascus. Source: Nizar Madani

A CASE FOR PROTECTION



UNDERGROUND HOSPITALS ACROSS SYRIA:

SAVE LIVES.

“ THE PERCENTAGE OF INJURIES WILL DECREASE A LOT IN THE CASE OF AN ATTACK WHEN THE FACILITY IS UNDERGROUND.

If we look at the direct attack in April 2016 on Al Quds Hospital in Aleppo, which was above the ground, there were over 50 people killed, including 6 staff, and dozens of injuries. If we compare this attack to similar strikes on M10, which was nearby and underground, you will find so many fewer injuries, and no deaths.”

Dr. Abdolsalam Daif, Turkey Country Director
Syria Relief and Development

There have been over 814 health workers killed between March 2011 - February 2017.³ Hundreds of patients have also been killed in aerial attacks on hospitals.

No health workers have been killed from aerial attacks in fully underground hospitals.⁴

“ UNDERGROUND, YOU WILL MAINTAIN YOUR EQUIPMENT. IT WILL NOT TO BE DAMAGED. YOU WILL PROTECT MEDICAL STAFF. YOU WILL SAVE LIVES. BEING UNDERGROUND WILL ENCOURAGE PEOPLE TO COME TO FACILITIES WHEN THEY NEED TREATMENT BECAUSE IT WILL BE SAFER.”

Dr. Abdulkhalek, Ophthalmologist
Al Hayat (M3) Hospital, East Aleppo

UNDERGROUND HOSPITALS ACROSS SYRIA:

PRESERVE DONOR-FUNDED EQUIPMENT.

Underground hospitals are financially responsible. These facilities are able to withstand aerial attacks more effectively than above-ground facilities, lessening the costs and time of changing the facility location and maintenance costs after a hospital is targeted.

Underground hospitals are designed to withstand multiple attacks, while above-ground hospitals can be destroyed by a single airstrike, and forced to move location several times. **“It is costly to build an underground hospital, but cost effective if the hospital is targeted by an airstrike,”** said Hisham Dirani, Executive Director and Co-founder of Binaa, a Syrian organization that provides humanitarian assistance and development inside of Syria. Binaa has taken the lead in engineering and building the infrastructure for 7 underground hospitals alongside Syrian medical NGOs and health directorates.

Underground facilities are also able to preserve critical life-saving equipment. The Central Cave Hospital in Hama has four operating rooms, each containing key operating equipment provided by the WHO, including anesthesia equipment, OR tables, surgical lights, surgical headlights, vital signs monitors, defibrillators, suction devices, and surgical kits. Despite being directly hit by aerial attacks three times, no equipment has been damaged or lost. This is a stark contrast to above-ground facilities. On April 2, 2017, one of SAMS’s above-ground facilities in Idlib was targeted by air-to-surface missiles which exploded inside the operating room, located on the ground floor. This single attack resulted in immense damage, including to the same types of major equipment that is safely housed in the Central Cave Hospital - anesthesia machines, OR tables, newborn ventilators, dialysis machines, and OR lights. **Preliminary repair costs are estimated at \$650,000.** With the expenses of providing new equipment and new hospital infrastructure after above-ground hospital attacks - in addition to factors such as the time that hospitals are unoperational in between attacks, the bureaucratic hurdles during that period, and most importantly, the human toll - it does not take many attacks to make underground hospitals cost-effective.

UNDERGROUND HOSPITALS ACROSS SYRIA:

PROVIDE A SENSE OF SECURITY THAT ALLOWS HEALTH WORKERS TO STAY IN SYRIA, LIMITING DISPLACEMENT.

“ THE LACK OF SAFETY WAS THE BIGGEST WORRY FOR US.”

Dr. Mohamad Abu Rajab, Radiologist
Al Sakhour (M10) Hospital, East Aleppo

“ ONE IMPACT OF UNDERGROUND HOSPITALS IS THAT THEY KEEP DOCTORS IN THE COUNTRY AND ATTRACT STAFF TO COME BACK.

After launching one of the major underground hospitals, we received offers from specialized doctors who had fled Syria because they felt they could not safely work. With this hospital, they felt it was their duty to come back, because they could help safely. We have so few specialized physicians now in Syria, that if we lose more health staff, there is no value in our facilities, above or under the ground.”

Dr. Khaled Almilaji, Chair of the Sustainable International
Medical Relief Organization (SIMRO)

**THERE IS A GLOBAL
AVERAGE OF 13 DOCTORS
AND 28 NURSES & MIDWIVES
FOR EVERY 10,000 PEOPLE.**

**IN SYRIA, THERE
ARE 2 DOCTORS AND
4 NURSES & MIDWIVES FOR
EVERY 10,000 PEOPLE.⁵**

Thousands of medical professionals have left Syria since 2011 to escape the threat of detainment and the constant risk of death. Between 2011 and 2014 alone, an estimated 15,000 doctors fled Syria - more than half of the 30,000 doctors in Syria before 2011.¹² The remaining physicians and medics operating in opposition-held areas have made the decision to risk their lives daily to treat others - the biggest challenge is the targeting of medical facilities by airstrikes. The relative security of underground hospitals allows medics to stay inside of Syria, and has even incentivised Syrian medical specialists to return to Syria, which in turn helps prevent the displacement of entire communities.

**“ THE FORTIFICATION OF HOSPITALS IS
NECESSARY. HOSPITALS ABOVE THE
GROUND DO NOT GIVE THE STAFF
AND PATIENTS A SENSE OF SECURITY
AMIDST THE INSECURE ENVIRONMENT.”**

Dr. Mohammad Bakour, Medical Director
Central Cave Hospital, Hama

RECOMMENDATIONS

**“ THE BEST SOLUTION NOWADAYS
ARE THE UNDERGROUND AND CAVE
HOSPITALS.”**

Dr. Mansour, Orthopedic Surgeon at a medical
point in Idlib (unnamed for security)

“ TWO BIG THINGS SHOULD BE DONE FOR PROTECTION IN EACH AREA: A SERIOUS FORTIFICATION PROJECT OF AT LEAST ONE HOSPITAL IN EACH AREA, AND BUILDING AN ALTERNATIVE UNDERGROUND HOSPITAL WHERE MEDICAL STAFF CAN WORK IN CASE THE PRIMARY HOSPITAL IS BOMBED.”

Dr. Abou Yaser, Hospital Manager
hospital in East Ghouta

Protection continues to be the most critical challenge and priority for health workers in Syria. The fortification of existing facilities and the creation of underground facilities are the most effective ways to operationally provide protection to medical personnel and patients, incentivise medical personnel to continue to work in Syria, and preserve medical equipment and infrastructure. Governments should prioritize the immediate protection of civilians and a sustainable political solution to the conflict, and their donor branches should prioritize supporting the local ways that medical organizations are able to offer even the most minimal protection measures.

TO THE INTERNATIONAL COMMUNITY:



GET SERIOUS ABOUT PREVENTING ATTACKS ON HOSPITALS.

The failure of the international community to meaningfully respond to over 454 attacks on hospitals, 91% by Assad and allies,¹ emboldens the Syrian government and Russia to continue committing these war crimes with impunity. We need tangible, substantive steps to end the systematic targeting of hospitals and all civilian areas in Syria. It has been one year since the May 3, 2016 passage of UN Security Council Resolution 2286 condemning attacks on health facilities and medical personnel in conflict - and there have been over 100 attacks on hospitals in Syria since. Enough is enough. All states and the UN should take swift measures to prevent continued violations of IHL, including taking measures under Chapter VII of the UN Charter.

TO DONOR COUNTRIES:



BROADEN PROTECTION FUNDING.

State donors should open up funding regulations to prioritize the protection of medical facilities. The fortification, rehabilitation, and underground rebuilding of hospitals fits into the goal of emergency and life-saving assistance, not only long-term development. The often inflexible divide between humanitarian relief and development funding creates a funding gap for activities that bridge the two, such as underground hospitals which offer immediate protection and are also theoretically long-lasting infrastructure. Budget lines for existing protection mainstreaming, rehabilitation, and maintenance of facilities should be broadened to include the maximum possible options to rebuild medical facility infrastructure and fortify existing infrastructure.



ALLOW MORE FLEXIBLE FUNDING TO SYRIAN NGOs.

Donors should provide more direct and flexible funding to Syrian NGOs. States should consider appropriating a sizeable bucket of funds each year to be made available on an open and competitive basis for Syrian NGOs to apply for one-time grants, with a priority on protection.



FULLY FUND THE HUMANITARIAN POOLED FUNDS.

Donors should increase their annual funding to the Turkey and Jordan Humanitarian Pooled Funds (HPF). One of the aims of the Turkey Humanitarian Pooled Fund is to provide funding to Syrian NGO projects, and funding is allocated for projects based on UN cluster-driven priorities. This fund is one of the only continuous sources of funding for Syrian NGOs, and supports projects that Syrian NGOs prioritize but are often underfunded, such as support for besieged areas and rehabilitation of medical facilities. In 2015, the Turkey HPF allocated \$1.5 million to “projects that seek to construct or renovate reinforced or underground Trauma Management facilities, capacity build clinical staff and replace ambulances destroyed in recent barrel bomb attacks” [23] based on the priorities set forth by the Health Cluster. Increased support for the Turkey and Jordan HPFs allow for increased funding for underground and fortified medical facilities, with the distribution overseen by UN OCHA and WHO.

TO INDIVIDUALS AND DONORS:



SUPPORT UNDERGROUND AND FORTIFIED HOSPITALS IN SYRIA.

With the lack of major direct donor funding, private funding and sub-grants for underground hospitals has become a lifeline. NGOs and pooled funding groups should prioritize the needs of local Syrians, and invest in the protective measures of underground hospitals.



PRIORITIZE PROTECTION OF STAFF.

All organizations that support staff inside of Syria should internalize principles of duty of care, the obligation to provide a reasonable standard of care for staff engaging in dangerous work, and protection for their Syrian partners. While numerous donors support Syrian medical staff, empowering them to take on the risk of treating patients while under attack, and fund operating costs of hospitals, very few provide funding for increased protective measures like the reinforcement of facilities or rebuilding of hospitals underground. Donors should prioritize such local recommendations for protection-oriented funding and advocate for the physical protection of their Syrian partners at all levels.

“ WITHOUT ACCOUNTABILITY, BOMBING HOSPITALS AND TARGETING HEALTHCARE WORKERS WILL BE NORMALIZED IN OTHER CONFLICTS AS IT WAS NORMALIZED IN SYRIA. OVER 150 YEARS OF HUMAN PROGRESS SINCE THE GENEVA CONVENTIONS WILL BE ERASED.”

Dr. Zaher Sahloul, Past President
Syrian American Medical Society (SAMS)

ENDNOTES

1. "Anatomy of a Crisis: A Map of Attacks on Health Care in Syria." Physicians for Human Rights, accessed on 19 April 2017. https://s3.amazonaws.com/PHR_syria_map/web/index.html
2. "Press Release: Medical Facilities in Syria Face Heightened Attacks." Syrian American Medical Society, 28 April 2017. https://www.sams-usa.net/press_release/medical-facilities-syria-face-heightened-attacks-24-attacks-april-alone/
3. "Health workers and the weaponisation of health care in Syria: a preliminary inquiry for The Lancet–American University of Beirut Commission on Syria." Fouad, F., Sparrow, A. et al. *The Lancet*, 14 March 2017. [http://thelancet.com/pdfs/journals/lancet/PIIS0140-6736\(17\)30741-9.pdf](http://thelancet.com/pdfs/journals/lancet/PIIS0140-6736(17)30741-9.pdf)
4. Data compiled by the Turkey-based Health Cluster serving Syria. Under their methodology, until recently, no staff or patients had been killed from an attack in a fully underground hospital. The sole exception is April 22, 2017, when the Abdeen Hospital in Hama was hit directly with a bunker buster bomb, killing 4 patients and injuring 2 health workers. The mountain that this hospital was built in was composed of fragile rock, and the hospital was built without an engineering study, underlining the importance of thorough engineering best practices for fortification and rebuilding underground. There have been other rare instances of indirect deaths from aerial attacks on underground hospitals, such as Dr. Ali Darwish, who died on March 25, 2017 of chemical exposure after an attack on the Latamneh Hospital in Hama when he refused to leave the side of a patient he was treating.
5. "Syrian Hospitals Surveillance Study." Union of Medical Care and Relief Organizations (UOSSM), March 2017. http://www.uossm.org/syrian_hospitals_report_march_2017
6. Data compiled by the Idlib Health Directorate.
7. "Breaking Aleppo." The Atlantic Council, February 2017. <http://www.publications.atlanticcouncil.org/breakingaleppo/>
8. Independent International Commission of Inquiry on the Syrian Arab Republic. "Conference Room Paper: 'Assault on medical care in Syria' - A/HRC/24/CRP.2 13. September 2013.
9. "Doctors in the Crosshairs: Four Years of Attacks on Health Care in Syria." Physicians for Human Rights, March 2015. https://s3.amazonaws.com/PHR_Reports/doctors-in-the-crosshairs.pdf
10. "Syria: Attacks on Doctors, Patients, and Hospitals." Physicians for Human Rights, December 2011. https://s3.amazonaws.com/PHR_Reports/syria-attacks-on-drs-patients-hospitals-final-2011.pdf
11. Local Coordination Committees of Syria: <http://www.lccsyria.org/2076>
12. "Syria's Medical Community Under Assault." Physicians for Human Rights, February 2015. <http://physiciansforhumanrights.org/library/other/syrias-medical-community-under-assault.html>
13. "Syrian Medical Voices from the Ground: The Ordeal of Syria's Healthcare Professionals." Syrian American Medical Society and Johns Hopkins Bloomberg School of Public Health's Center for Public Health and Human Rights, February 2015. https://www.sams-usa.net/wp-content/uploads/2016/09/Syrian-Medical-Voices-from-the-Ground_F.pdf

14. "The Failure of UN Security Council Resolution 2286 in Preventing Attacks on Healthcare in Syria." Syrian American Medical Society, January 2017. <https://www.sams-usa.net/wp-content/uploads/2017/03/UN-fail-report-07-3.pdf>
15. Nassar, Alaa and Schuster, Justin, "Despite 50 feet of stone, 'bunker busters' wreck underground Hama hospital." Syria Direct, 3 October 2016. <http://syriadirect.org/news/despite-50-feet-of-stone-%E2%80%98bunker-busters%E2%80%99-wreck-underground-hama-hospital/>
16. "A New Normal: Ongoing Chemical Weapons Attacks in Syria." Syrian American Medical Society, February 2016 (statistic updated April 2017). <https://www.sams-usa.net/reports/a-new-normal-ongoing-chemical-weapons-attacks-in-syria/>
17. "Syria: Coordinated Chemical Attacks on Aleppo." Human Rights Watch, 13 February 2017. <https://www.hrw.org/news/2017/02/13/syria-coordinated-chemical-attacks-aleppo>
18. Dr. Abdulkhalek, Statement to the Senate Foreign Relations Committee, "Six Years of War in Syria: The Human Toll." 15 March 2017.
19. "Breaking: Syrian Doctor Killed by Chemical Weapons while Operating on Patient." Union of Medical Care and Relief Organizations (UOSSM), 25 March 2017. <http://reliefweb.int/report/syrian-arab-republic/breaking-syrian-doctor-killed-chemical-weapon-while-operating-patient>
20. "Waiting for No One: Civilian Survival Strategies in Syria." Center for Civilians in Conflict. April 2016. <http://civiliansinconflict.org/resources/pub/civilian-survival-strategies-in-syria>
21. "Syria's Next Aleppo? The War Crime of Forced Displacement." The Syria Campaign, 6 March 2017. <https://updates.breakthesieges.org/syrias-next-aleppo-war-crime-forced-displacement/>
22. "Turkey/ Syria: Developments in Idlib Governorate and Western Countryside of Aleppo." UN OCHA, 15 February 2017. <http://reliefweb.int/report/syrian-arab-republic/turkey-syria-developments-idlib-governorate-and-western-countryside>
23. Humanitarian Pooled Fund (HPF) in Turkey 2015, 2nd Standard Allocation Strategy Paper. UN OCHA, 2015. https://www.humanitarianresponse.info/en/system/files/documents/files/hpf_2015_sa2_allocation_paper_final_11_08_2015.pdf

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SAVING LIVES UNDERGROUND

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