

NON-FUNCTIONAL MEDICAL EQUIPMENT IN NW SYRIA

AN IN-DEPTH NEEDS ASSESSMENT

ANALYZING SCOPE AND EXPLORING
OPPORTUNITIES FOR RECYCLING AND REPAIR



About Field Ready

Field Ready is a group of organizations that is dedicated to preparing for and respond to the causes and consequences of disasters – one of the grand challenges to humanity. Founded in 2013, our unique approach is transformational and has worked in nearly 20 countries. Together:

1. We believe that by making useful things locally, we can make the world a better place and that people should have essential items where and when they need them.
2. Our vision is to meet humanitarian and reconstruction needs in ways that transform international aid for the better.
3. Our goals are to save lives and reduce suffering while increasing resilience and empowerment in the communities we serve.
4. We localize manufacturing by bringing it to challenging places, training others and creating innovative solutions by engaging people in new ways.
5. Our values include respect for others, a bias toward action, learning, and a lean and agile approach to support people's rights and dignity.
6. We initially focus our efforts on humanitarian contexts and stay through reconstruction to help the communities we serve to develop and be resilient beyond our presence.
7. We subscribe to widely accepted humanitarian principles and endeavor to be a reliable and impactful partner everywhere we work
8. Ultimately, we created and strive to extend our approach everywhere it can make a profound impact.

Together, we believe that everyone should have the supplies they need, where they need them and when they need them. This means that:

- Relief, recovery and reconstruction should be better, faster and cheaper
- Reliance on fragile and costly supply chains is reduced and local economies are boosted because supplies that can be made locally are made locally
- Aid is delivered more efficiently and effectively because needed supplies are available
- Resilience and preparedness improve because people have access to production tools and support to aid in an area's recovery

About Field Ready Türkiye (The Local Implementing Partner)

Field Ready Türkiye (Sahaya Hazir İnovasyon Derneği) is a group of engineers and humanitarian aid and development sectors experts. We have been working in NW Syria and in Türkiye since 2016. We received our legal registration in Türkiye in February 2021 as a Social Community Organization that seeks to find innovative solutions for the communities' challenges.

Our Vision is to be a leading force in empowering local communities through innovative solutions and entrepreneurship, creating a sustainable impact wherever and whenever is needed.

Our mission is to work within and to empower, local communities to create sustainable solutions through innovation and entrepreneurship. We believe that by making things locally, we can make the world a better place. As an NGO, Field Ready Türkiye is a part of the global movement to change and to make what is needed, locally, by local makers, and innovators.

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Field Ready Türkiye starts with the end-user and works to solve their problems, with them. Through participatory development techniques and Human Centred Design, Field Ready engages end users in every step of program delivery – from needs assessment to our exit strategy.

Our solution involves working closely with end users to understand problems and develop solutions. Our aim is to respond rapidly and address problems that may have been overlooked or deemed “too hard” by other humanitarian responders.

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Executive Summary

The healthcare sector in northwestern Syria is the lifeline of the region as it provides healthcare services to a population of approximately 4.5 million people. About two million of whom residing in camps¹ under unsanitary living conditions due to the lack of clean water sources, inadequate sewage systems, and severe overcrowding in the camps. Consequently, this has led to the spread of various diseases, such as Cholera and Hepatitis, which are among the most dangerous diseases. About 3.1 million individuals living in northwestern Syria are in need for health care and assistance according to United Nations estimates.²

Healthcare sector faces numerous challenges that hinder its ability to provide optimal healthcare services to patients. These challenges include a significant number of healthcare facilities and hospitals going out of service due to being targeted by regime forces and its allies, or due to damage caused by earthquake that struck the region. In addition to a scarcity of medical supplies and materials, and a severe shortage of technical and medical staff. Importantly, there is a significant shortage in medical devices, either because these devices were never provided or because they are non-functional irreparable.

This study was conducted to identify the magnitude of the problem of medical device malfunction in northwestern Syria. The study aims to identify the number of malfunctioning devices in hospitals and healthcare facilities, as well as its impact on providing healthcare to patients and healthcare seekers. It also aims to determine the extent of reparability of the devices and the availability of repairing capacities. Furthermore, the study aims to identify the main obstacles and challenges that hinder repair operations.

This study was conducted during July and August of 2023, with a sample of 40 healthcare facilities in Idlib and Aleppo countryside, taking into account the population distribution in each area, as a larger number of hospitals were targeted in areas with higher population density. During field visits to these hospitals, interviews were conducted with the managers of the hospitals or the maintenance departments' officials, or both of them. Additionally, the study involved interviews with two Health Directorates' representatives, one from Idlib and the other from Aleppo countryside. Furthermore, three medical device maintenance experts were also interviewed, two of whom in Aleppo and one in Idlib. All of the aforementioned interviews were conducted face-to-face and recorded using paper forms.

The study concluded with a set of key findings, one of the most prominent of which is the existence of a significant number of malfunctioning medical devices, estimated at 873 devices, knowing that many of these malfunctioning devices are of paramount importance to repair, due to the lack of alternative devices in the region. These devices

¹ [North-west Syria | Situation Reports \(unocha.org\)](https://www.unocha.org/syria/reports/situation-reports)

² [Syria: WHO issues emergency appeal for \\$257.6 million for health care in the country | UN News \(un.org\)](https://www.un.org/en/news/story/2023/05/syria-who-emergency-appeal)

include CT scanners, MRI machines, kidney dialysis machines, lithotripsy devices, ophthalmic surgery devices, and a cardiopulmonary bypass; a device used in open-heart surgeries, as only one device of this type exists in northwestern Syria (Idlib and Aleppo), and it is currently non-functional. The malfunctioning of these devices significantly impacts patients, as they are forced to wait for extended periods, sometimes extending to several months, to receive necessary healthcare services, causing increased mortality rates or reduced chances of patient recovery due to delayed diagnosis.

Key findings of the study, summarized below, have shown that the vast majority of malfunctioning medical devices are repairable. However, various obstacles and challenges hinder the repair process. Among the most prominent of these obstacles are the high maintenance costs, coupled with insufficient hospitals budgets, a substantial shortage of necessary spare parts, and a lack of skilled maintenance technicians and specialists. This is even more challenging knowing that some types of malfunctions cannot even be repaired by technicians in the region due to their lack of experience in addressing such malfunctions.

In view of the foregoing, we stress that it is necessary for the international donors to increase the amount of support allocated to the healthcare sector in northwestern Syria. We also recommend providing medical supplies and medications to hospitals and healthcare facilities, providing necessary assistance to hospitals for repairing malfunctioning devices, which can be achieved by establishing workshops for medical device maintenance, in addition to launching training programs on medical device maintenance to qualify a number of engineers in northwestern Syria. It is essential to train hospital staff on operating and maintenance of medical devices. We also recommend providing spare parts, which can be achieved through supporting the establishment of workshops for manufacturing parts locally and encouraging coordination between hospitals for the recycling of irreparable devices and the exchange of spare parts.

Key Findings

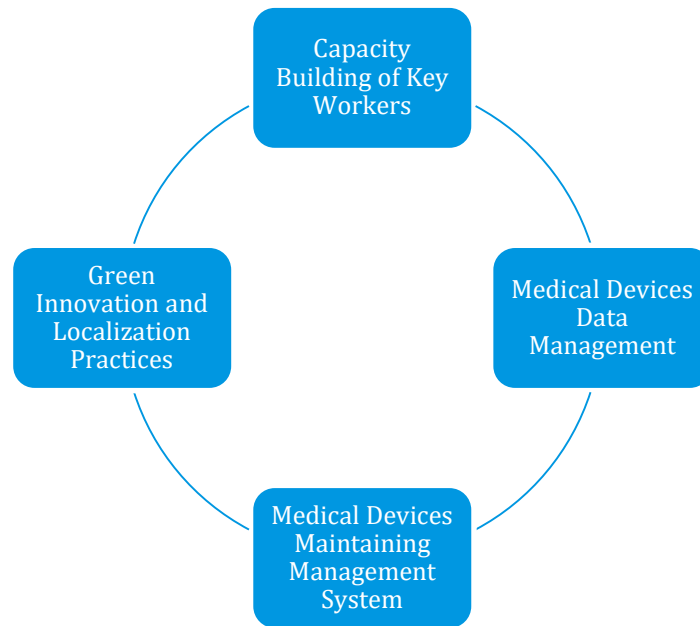
- 1- Health sector in northwestern Syria faces several challenges that hinder the provision of healthcare to patients and healthcare seekers, and these challenges, as stated by representatives of health directorates and representatives of healthcare facilities and hospitals, mainly include the following:
 - The small number of healthcare facilities operating in the area, and the lack of hospitals that perform surgeries, according to the representative of the Directorate of Health in Aleppo countryside.
 - The significant shortage in the number of medical devices and equipment, especially MRI and CT devices.
 - The representative of the Directorate of Health in Idlib believes that the most prominent challenges facing them are the lack of medications, equipment and devices necessary to provide healthcare and treatment for cancer patients and open-heart surgery patients.
 - The lack of sufficient medical devices that are necessary to provide healthcare for care seekers visiting healthcare facilities and hospitals, according to the statements of representatives of the health directorates in Idlib and Aleppo and 79% of representatives of healthcare facilities and hospitals.
 - The large number of malfunctioning medical devices.
 - 43% of hospital representatives said they suffer a shortage of medical staff.
 - About one-third of hospital representatives said they suffer a shortage of technical staff.
 - Shortage in the number of specialists in the field of medical devices maintenance and repair.
 - Scarcity of medications and medical supplies.
- 2- The number of non-functional medical devices in surveyed healthcare facilities and hospitals reached 873 devices.
- 3- According to representatives of the health directorates in Idlib and Aleppo, the most prominent repercussions of the malfunctioning of medical devices on patients are as follows:
 - Increased mortality rates.
 - Patients have to wait for extended periods of time to receive healthcare.
 - Delay in diagnosing the cases, which reduces the chances of patients' recovery.

- 4- According to representatives of the Idlib and Aleppo health directorates CT devices, magnetic resonance imaging (MRI) machines, dialysis machines, lithotripsy machines, ophthalmic surgery devices and laparoscopic surgical devices are a priority for repair.
- 5- According to the representative of Al-Hedaya Hospital, there is only one cardiopulmonary bypass device in northwestern Syria, which is used in open-heart surgeries, and it is located in Al-Hedaya Hospital. This device is currently non-functional and it is a top priority for repair.
- 6- The number of patients who can benefit from malfunctioning medical devices, if repaired, is estimated at 656,149 patients per month.
- 7- More than three-quarters of healthcare facilities and hospitals conduct periodic examination of medical devices, and this examination is done on a monthly or weekly basis.
- 8- According to the hospital representatives, the reason why some healthcare facilities and hospitals do not conduct a periodic examination of the devices is due to the lack of maintenance departments in these facilities or the unavailability of the necessary equipment to conduct the examination.
- 9- More than half of healthcare facilities and hospitals (55%) do not have maintenance departments.
- 10- 81% of the non-functional medical devices are reparable.
- 11- Healthcare facilities and hospitals face many obstacles that hinder their ability to repair non-functional devices, and according to hospital representatives, representatives of health directorates, and maintenance experts, these obstacles primarily include:
 - High costs of repairing medical devices, considering that hospitals lack sufficient budgets to cover these costs.
 - Unavailability of spare parts needed to repair the devices.
 - Unavailability of the necessary equipment to repair devices, such as calibration and measuring tools.
 - The significant shortage in the number of technical specialists in northwestern Syria.
 - The available technical specialists do not possess the required experience and competence to handle some types of devices or malfunctions.
- 12- According to the representatives of health directorates and the findings of field visits to hospitals, mechanical and electrical malfunctions are the most common types of malfunctions, followed by electronic and software-related malfunctions.

- 13- The misuse of medical devices is one of the prominent reasons that cause malfunctions, as about 20% of the malfunctions result from mistakes of the hospitals' staff in operating the devices.
- 14- About a third of the participants from the representatives of healthcare facilities said that the hospitals staff need to be trained on how to operate some types of devices.
- 15- According to representatives of health directorates and representatives of hospitals, there is a significant shortage in the quantities of spare parts available in northwestern Syria.
- 16- The problem of shortage of spare parts can be addressed by establishing workshops to manufacture parts locally.
- 17- According to health directorate representatives and maintenance experts, establishing spare parts manufacturing workshops, requires obtaining legal permits, providing equipment, and qualifying a specialized technical staff of engineers, medical technicians, mechanics, electricians, and programmers.
- 18- Representatives of health directorates and maintenance experts believe it is possible to utilize the components of irreparable medical devices as spare parts to repair non-functional medical devices.
- 19- About two-thirds of healthcare facilities and hospitals are willing to exchange components of their irreparable medical devices with other healthcare facilities and hospitals.
- 20- Less than a quarter of healthcare facilities and hospitals are already coordinating with other health facilities and hospitals to exchange spare parts they have.
- 21- The vast majority of healthcare facilities and hospitals (88%) are willing to cooperate with any parties that coordinate between healthcare facilities and hospitals to recycle spare parts.

Recommendations

We recommend a set of integrated initiatives that together aim to support the medical devices supply chain, which will ultimately support the health sector in the north of Syria.



Development initiatives to support the medical devices supply chain

1. Capacity Building of Key Workers:

- A. Establish Strategic Workshops for Enhanced Repair Efficacy: Set up two workshops in pivotal locations, Azaz and Dana, covering most repair cases across a majority of NW Syrian hospitals. These workshops specialize in recycling and repairing diverse medical items, prolonging device lifespans and enhancing the sustainability of healthcare delivery.
- B. Equip Engineers and Technicians with Diverse Repair Skills: Train approximately 15 engineers and technicians to handle a range of repairs, both minor and major. This training equips them to address various medical device maintenance needs effectively.
- C. Empower Indigenous Manufacturers through Comprehensive Training: Provide comprehensive training to 20 local manufacturers, empowering them to repurpose e-waste components for repairing non-functional medical equipment. This initiative not only curbs e-

waste accumulation but also bolsters the availability of vital healthcare devices.

- D. Enhance Diagnostic and Repair Expertise: Provide training to healthcare staff on early diagnostic practices for medical devices, while equipping technical personnel with the skills to manage intricate repairs.

2. Medical Devices Data Management:

- E. Create an Intuitive Mobile App for E-Waste Reporting: Develop a user-friendly mobile application that streamlines e-waste reporting for healthcare institutions. This app not only aids in addressing environmental issues but also identifies healthcare facilities in need of assistance, serving as an indispensable resource.
- F. Develop User-Friendly App for Spare Parts Management: Design an intuitive mobile app for spare parts reporting, aiding in addressing environmental concerns and identifying healthcare facilities willing to contribute spare parts and broken devices for recycling and reuse.

3. Medical Devices Maintaining Management System:

- G. Prioritize Repair for Critical Medical Equipment: Give priority to repairing essential equipment, including central axis tomography, magnetic resonance imaging devices, kidney dialysis machines, lithotripsy devices, ophthalmic surgery devices, and endoscopic surgical instruments. The CPB machine used in open-heart surgeries holds the highest priority due to its rarity and non-operational status in northwest Syria.
- H. Implement Regular Preventive Maintenance (PM) Interventions: Establish 6 specialized teams to perform regular preventive maintenance (PM) in hospitals lacking maintenance departments. This proactive approach ensures the ongoing sustainability of healthcare services in NW Syria.
- I. Support Establishment of Maintenance Departments: Facilitate the establishment of maintenance departments in hospitals without such facilities, targeting approximately 25% of hospitals. This strengthens the infrastructure for effective medical device maintenance.

4. Green Innovation and Localization Practices:

- J. Promote Localization and Innovation through Makerspaces: Foster innovation and overcome parts scarcity by establishing makerspaces with digital fabrication tools like 3D printers, encouraging local solutions to device maintenance challenges.

- K. Set Up Central Warehouses for Efficient Resource Management: Create central warehouses in Azaz and Dana to collect and store spare parts and broken devices from various donors. This initiative reduces reliance on imports, promotes circular economy principles, and alleviates the pressure on spare parts availability.

Methodology of the Study

Objective of the study

The study aimed to identify the scale of the issue of medical devices malfunctioning in hospitals located in northwest Syria, and its impact on providing healthcare to patients and healthcare seekers. This objective was achieved by selecting a representative sample of hospitals and conducting a survey to determine the number of inoperative medical devices within them, in addition to identifying the types of malfunctions, their repairability, and the availability of resources for the repairs. Furthermore, the study aimed to reveal the most prominent obstacles and challenges hindering maintenance and reactivation of these devices. The study also aimed to assess the availability of maintenance requirements, such as spare parts and technical specialists.

Shedding light on this sensitive issue and understanding its causes, as well as the forms of support that hospitals need for the maintenance and reactivation of medical devices, will aid in formulating the most suitable solutions and providing recommendations for key projects that need to be implemented to repair and reintegrate the medical devices into service. This will have a positive impact on the medical sector's capacity in northwest Syria to provide healthcare to patients.

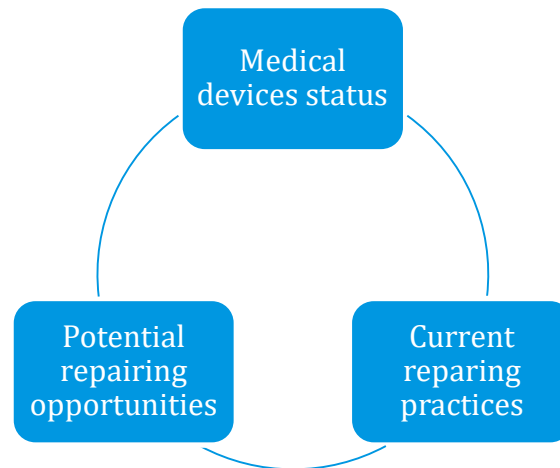
Table 1. Research objectives summary

Exploring	Innovating
Analyzing the scope and size of broken medical devices in health facilities in the north of Syria.	Developing a plan of maintaining the broken medical devices that can save resources and support localization.

Scope of study

Timeframe: The study was conducted during the months of July and August of 2023. Data collection process was conducted in July, while the report was written in August 2023.

Geographical Scope: The study included the northwestern regions of Syria, including Idlib, Afrin, Azaz, Jarablus, and Al-Bab. The distribution of the population in each of these areas was taken into consideration, whereas a greater number of hospitals was surveyed in the areas with higher population.

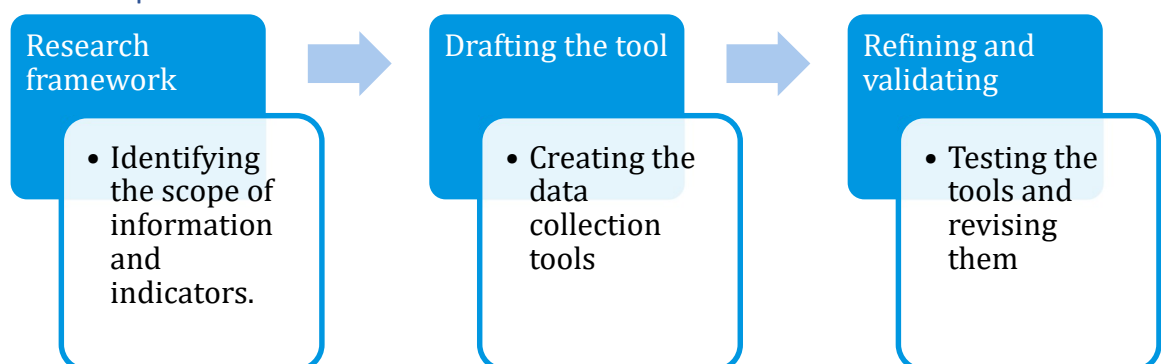


Indicators framework

Data sources

- 1- **Primary Data:** including KIIs with key informants from health directorates and technical specialists in the field of medical devices maintenance.
- 2- **Secondary data,** including research, reports and studies related to the issue under study.

Tools Development



Data collection tools were developed:

- 1- Health Facility Questionnaire: semi-structured questionnaire.
- 2- Maintenance experts' KII Guide: unstructured questionnaire (Open-ended questions).

- 3- Health Directorate Staff Interview Guide: unstructured questionnaire (Open-ended questions).

Data collection and analysis

Having developed the study tools, a training session was conducted for the data collectors. During this session, a detailed explanation of the project and its objectives and the target sample was provided, then, the tools were presented and discussed with the 4 data collectors, all of whom are of a medical background (nurses or former hospital technicians). After that, fieldwork took place during July 2023, as field visits were made to hospitals, healthcare centers, and health directorates, and data collection process was carried out, knowing that all interviews with hospitals' staff, health directorates' representatives, and key informants were conducted face-to-face and in paper forms, which were then sent by the enumerators to the data quality officer for revising and verification. Later on, hospitals' data was manually entered into a M.S Excel database for analysis.

Study Sample

The study sample included healthcare facilities and health directorates in Idlib and Aleppo, and key informants who are technicians specialized in the field of maintenance of medical devices.

With regard to health facilities, 40 hospitals and specialized medical centers (such as dialysis centers) in Aleppo and Idlib were visited, taking into consideration selecting facilities in various geographical areas to cover the largest possible area out of the targeted areas in order to reach representative results that reflect the true situation in all healthcare facilities in northwestern Syria. Accordingly, the number of targeted facilities in Idlib reached 24 facilities, while it was 16 facilities in Aleppo. During visits to hospitals, the manager of the hospital or maintenance department official was interviewed. Fields of specializations of the surveyed hospitals and facilities varied, as well as its operating entities as shown in the charts below:

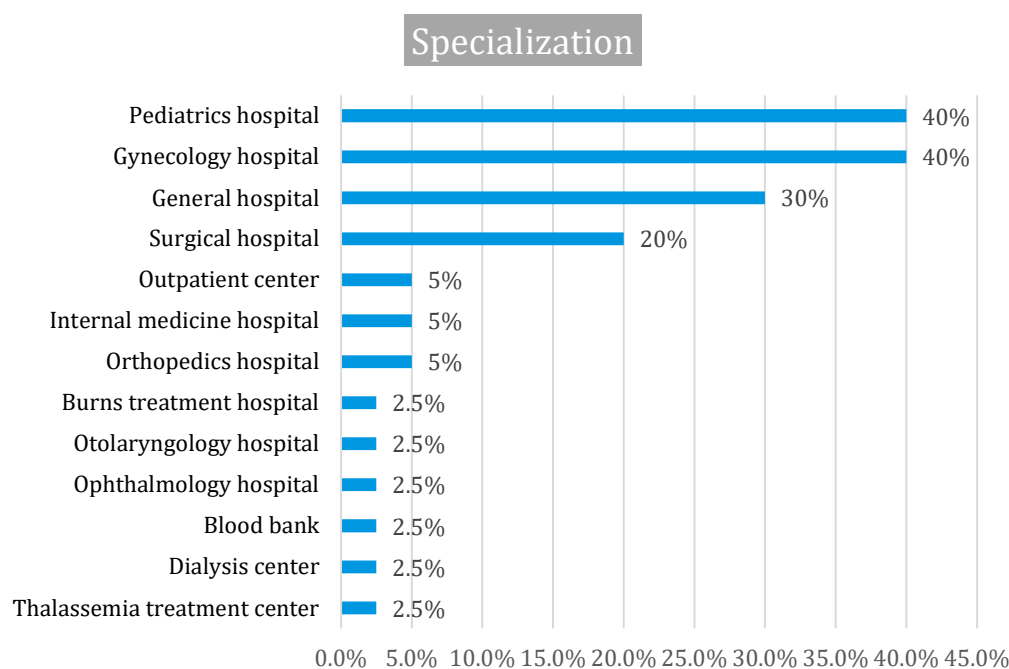


Figure 1 Healthcare facilities according to specialization

Note: Appendix at the end of the report includes a list of the healthcare facilities and hospitals visited, including their names, locations, and the specialization (Appendix A)

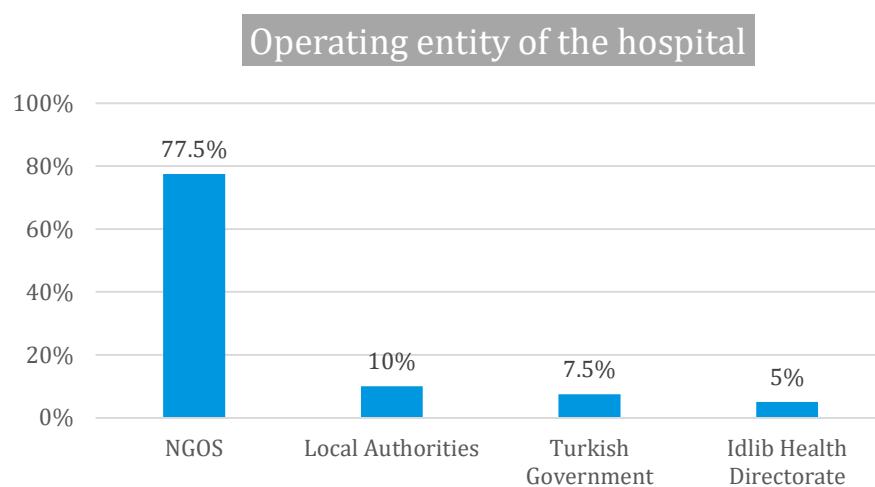


Figure 2 Healthcare facilities according to the operating entity.

Regarding the interviews with the health directorates, they were conducted with the Deputy Director of Idlib Health Directorate and the administrative director of the Afrin Health Directorate.

As for the medical devices' maintenance experts, three KIIs were conducted with maintenance technicians and specialists in northwestern Syria, including two KIIs in Aleppo countryside and one in Idlib.

Challenges

- 1- There was a delay in the time plan set for the completion of the study due to the slow response of hospitals and health authorities in the study areas.
- 2- Many hospitals and healthcare facilities who were contacted for participating in the study have apologized, either because they did not obtain the consent of the hospital's financial supporters, or because they receive support from multiple parties, which makes it difficult to obtain consent of all these parties.
- 3- Some health directorates in Aleppo countryside did not agree to participate, which caused some hospitals in their areas to refuse participation.

In general, the aforementioned challenges have resulted in the inability to achieve the planned number of 50 facilities, and only 40 were covered, and also caused delays to the planned schedule.

The status of the medical sector in northwest Syria

The health sector in northwest Syria is the most important sector, as it is the lifeline for the region's population of 4.5 million inhabitants, two million of whom live in camps³, and according to UN estimates, about 3.1 million of northwest Syria inhabitants need health care and assistance.⁴

Health sector faces significant challenges hindering its operation. Since the onset of the conflict in Syria, hospitals and healthcare facilities in areas beyond the control of the Syrian regime have been direct targets of the regime's forces and its allies, this caused a large number of healthcare facilities to become out of service. The World Health Organization has stated that there were 337 attacks targeting medical facilities in northwestern Syria between 2016 and 2019, stating that half of the 550 medical facilities have become out of service.⁵

On the other hand, the scarcity of support from international donors constitutes one of the foremost challenges facing the healthcare sector, as it has impeded the ability of hospitals and healthcare centers to provide services to the people of the area, as the healthcare sector in northwestern Syria completely relies on international support provided by the United Nations and NGOs. The support allocated for this sector has decreased by over 40%, resulting in a reduction of hospital capacity to less than 20%.

The population density adds to the pressure on hospitals and healthcare centers. This pressure has notably increased after 2020 due to the displacement of a significant

³ [North-west Syria | Situation Reports \(unocha.org\)](https://www.unocha.org/north-west-syria/situation-reports)

⁴ [Syria: WHO issues emergency appeal for \\$257.6 million for health care in the country | UN News \(un.org\)](https://www.un.org/en/news/story/2020/09/10/syria-who-issues-emergency-appeal-for-257-6-million-for-health-care-in-the-country)

⁵ [نقص المستلزمات والحاجة الماسة لها في مستشفيات الشمال المحرر \(violetsyria.org\)](https://violetsyria.org/)

number of residents from areas that became under the control of the Syrian regime during its military campaign in the countryside of Idlib. These areas were receiving health services from these hospitals, but they became impossible to reach after the regime extended its control over the area, knowing that no new hospitals were established in the areas to which IDPs have moved, which caused more pressure on the existing healthcare facilities.

Furthermore, the earthquake has exacerbated the aforementioned challenges by causing damage to several healthcare facilities, causing them to become out of service. According to the Syrian Network for Human Rights, a total of 55 healthcare facilities were damaged by the earthquake, which in turn caused an influx of a great number of injured people into the hospitals, which is beyond hospitals' capacity, given the severe shortage of medical consumables, equipment, and necessary medications for patient treatment,⁶ knowing that many of the wounded require specialized interventions and surgeries, such as reconstructive procedures, ophthalmic surgeries, and orthopedic surgeries.⁷

The earthquake has also caused the depletion of the health sector's stock of medicines and medical supplies, which are already scarce, as the Directorate of Health in Idlib, according to its public relations official, has depleted its entire medical stock in warehouses only three days after the earthquake,⁸ and the director of the media office said that medical facilities suffer a significant shortage of quality medicines, especially anesthetics and dialysis equipment supplies, as most of the wounded who were trapped under the rubble suffer from "crush syndrome," which resulted in kidney failure which made them in dire need for dialysis. The Directorate has also stated that hospitals are in dire need for infant incubators and intensive care medicines. On the other hand, the medical operations officer at Hand in Hand for Syria Organization said that hospitals suffer severe shortages of medical supplies, especially anesthetics, orthopedic drugs and serums.⁹

Maram Al-Sheikh, Minister of Health in the Syrian Interim Government, has warned of an impending humanitarian health catastrophe in northwestern Syria as a result of the collapse of the healthcare sector due to the earthquake. The Minister stated, "We have faced challenges before, but what lies ahead is even more difficult." Al-Sheikh is deeply concerned about the complete collapse of the healthcare system due to its depletion during the earthquake and the shortage of medical aid provided to northwestern Syria. He is also concerned about losing control over the treatment of chronic diseases due to the severe shortage of medications and medical supplies,

⁶ almodon.com (المدن - نفاد المخزون الطبي..يُنذر بانهيار القطاع الصحي شمال غرب سوريا)

⁷ irfaasawtak.com "The health sector in northern Syria after the earthquake. "Next Harder" (irfaasawtak.com)

⁸ Previous reference

⁹ alaraby.co.uk "The health sector in northwestern Syria: operating at maximum capacity and scarce capabilities (alaraby.co.uk)

along with the imminent threat to kidney patients, as kidney dialysis units became depleted and some of them became out of service.¹⁰

Al-Sheikh has also stated that a number of epidemics and communicable diseases such as measles and leishmaniasis have spread due to the destruction of infrastructure, the difficulty of accessing clean water and overcrowding in random informal camps, which is confirmed by a report issued by Doctors without Borders Organization (Médecins Sans Frontières), which confirmed that the destruction of infrastructure in northwestern Syria due to military operations and the devastating earthquake that struck the region has a clear impact on increasing the burden on the health sector, as the damage to sewage networks, the lack of clean water sources, the use of polluted water, overcrowding in the camps and the lack of healthcare facilities caused the spread of many diseases such as Cholera, Hepatitis, Leishmaniasis and Scabies, and the number of infected people has increased."¹¹

The aforementioned challenges are exacerbated by the significant shortage of medical staff, especially since the largest proportion of medical workers have left the country, either due to the risks resulting from military operations or because of the cease of support, and the International Rescue Committee (IRC) has stated that about 70% of medical sector workers have left the country and the service ratio is now one doctor per 10,000 inhabitants.

On the other hand, the healthcare sector in northwest Syria is suffering a significant shortage of medical devices and equipment, particularly magnetic resonance imaging (MRI) and computed tomography (CT) scanners. Dr. Samer Al-Alwan, radiologist and medical director of the Advanced Diagnostic Center in Idlib, stated that due to the circumstances of war, all services have deteriorated, but the medical sector has been the most affected due to lack of electricity, destruction of medical facilities and centers, scarcity of medical supplies and equipment which made it extremely expensive, and high operational costs. Among these devices, the CT scanner, which was rarely available for the last four years, as the available CT scanners in the region doesn't cover the population's needs. Similarly, MRI machines are extremely scarce, requiring patients to be placed on waiting lists, with waiting times potentially exceeding a minimum of four months. Additionally, fluoroscopy devices used for contrast imaging of medical pathways are utterly unavailable.¹²

Representatives of health directorates who were interviewed affirmed that the healthcare sector is facing several obstacles and challenges. In Idlib, the Deputy Health Director said that the most pressing challenge they face is the absence of treatment options for cancer patients and those requiring open-heart surgery. Previously, these patients were transferred to Turkey for treatment, but currently, they are no longer allowed, and the region lacks the resources to provide them with care, as essential

¹⁰ Previous reference

¹¹ [Invisible health risks for displaced people in northwest Syria | Médecins Sans Frontières \(msf.org\)](#)

¹² [Popular donations to buy them. Scarcity of medical devices in northern Syria compounds the suffering of the afflicted | Politics | Al Jazeera Net \(aljazeera.net\)](#)

medications, equipment, and necessary devices for providing care for them are unavailable. Furthermore, there is a shortage of infant incubators, diagnostic tools, and ventilators.

The Administrative Director in Afrin's Health Directorate stated that the most significant challenges the healthcare sector is facing include a shortage of medical personnel such as doctors, nurses, and maintenance technicians and specialists. In addition, there is a scarcity of operational medical centers in the area, and the region also lacks hospitals where surgical procedures can be conducted, as there are only specialized clinics offering primary care for patients.

On their part, representatives of the surveyed medical facilities said that they face numerous challenges in providing healthcare to patients. These challenges primarily include a shortage of doctors, nurses, and technicians, as well as a shortage of medicines and medical supplies. The most significant issue, however, is the unavailability of necessary medical equipment for patient examinations.

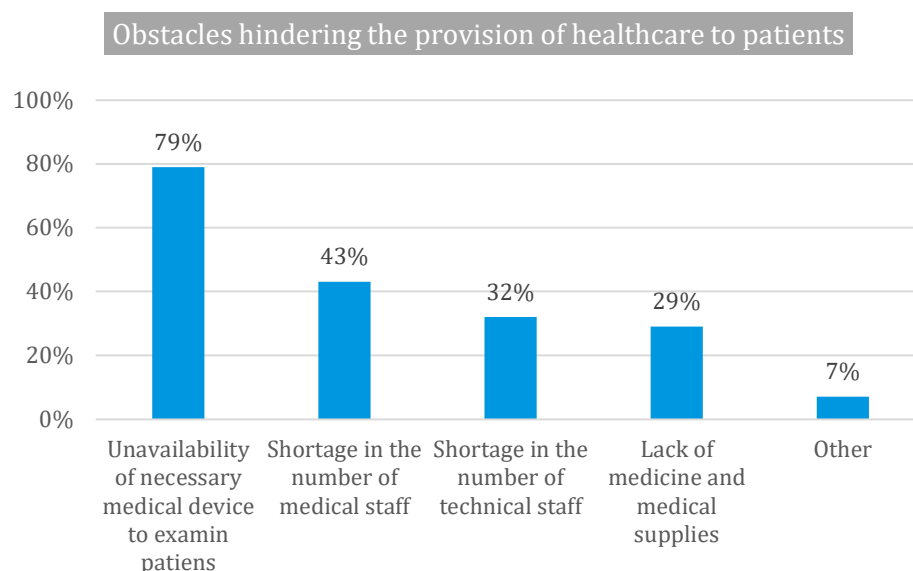


Figure 3 Obstacles to providing health care.

Note: The option (OTHER) primarily includes the cessation of funding.

The magnitude of the problem of malfunctioning devices

The problem of medical device malfunction is one of the most prominent and widespread issues in northwestern Syria. During the interview with the Deputy Director of Idlib Health Directorate, he stated that the majority of equipment in hospitals require cessation of services, and that their malfunctions have become very frequent. He also stated that this problem faces all medical facilities that provide healthcare for patients, as a significantly high percentage of medical devices have exceeded their expected lifespan without being replaced. Even in cases where hospitals acquire devices through donations, these devices are basically secondhand

devices. These statements are also similar to the statements of the representative of the Health Directorate in Afrin during the interview with him.

Data obtained during field visits to hospitals reveal a high number of malfunctioning medical devices, as the total number reached 873 malfunctioning devices, with one hospital having 131 medical devices that are out of service.

There were numerous types of malfunctioning medical devices, with a noticeable discrepancy in the number of malfunctioning devices according to the type, as the number of malfunctioning monitor devices was the highest, reaching 119 devices, and the numbers of malfunctioning ECG devices, ultrasound scanning devices, sterilizers, ventilators, suction devices, anesthesia machines, and fetal doppler devices were also high, in addition to many other types of devices as shown in the chart below:

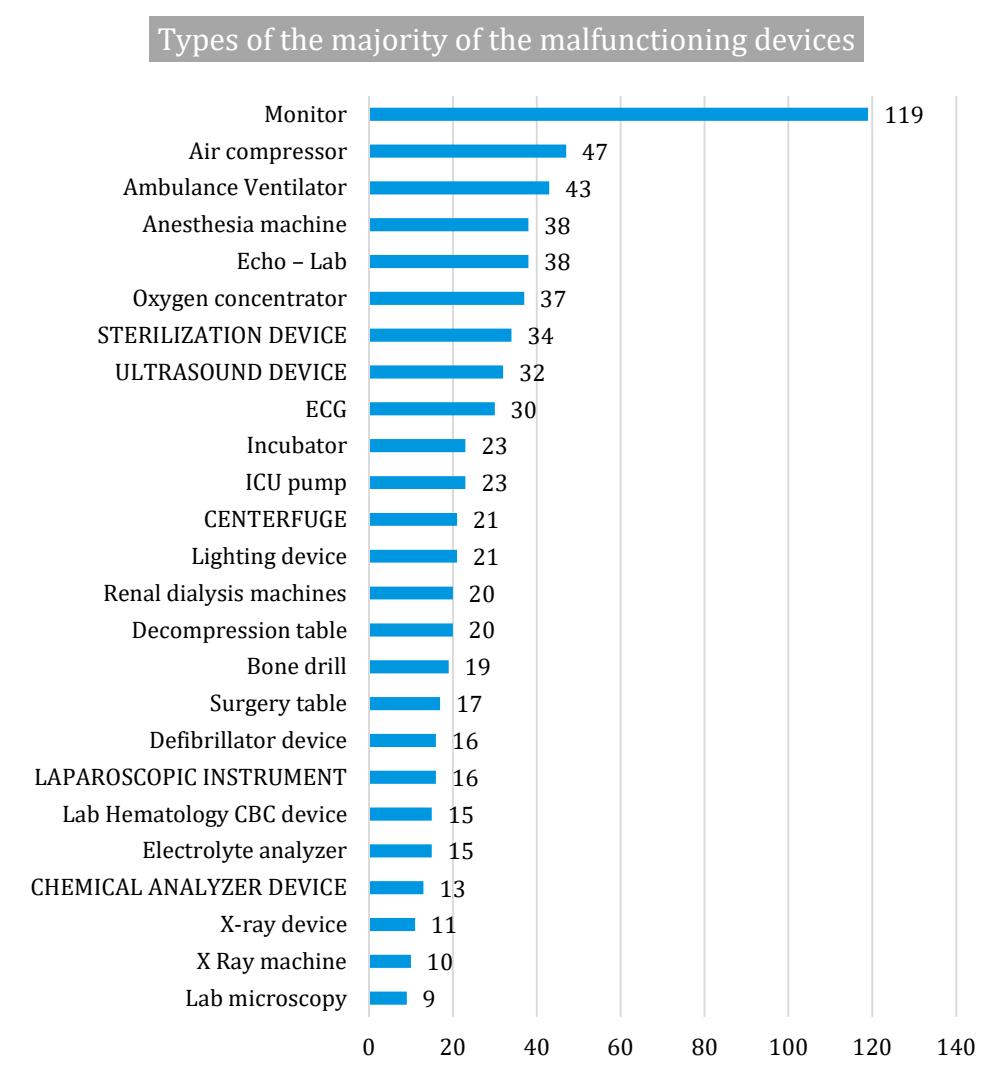


Figure 4 Types of the majority of the malfunctioning devices

Note: The Appendix at the end of the questionnaire includes a list of the types of medical devices with few malfunctions (Appendix B).

Repercussions of the malfunctioning of medical devices on the health sector

As previously mentioned, healthcare facilities in northwestern Syria are facing an increase in the number of patients and healthcare seekers, which was confirmed by the findings of the study, as the total number of healthcare seekers who visited the surveyed facilities reached 370,500 patients per month, at an average of approximately 9,270 visitors per healthcare facility per month. It is worth noting that in some hospitals, the number of patients can reach 20,000 to 30,000, as is the case in Azaz Hospital, Atma Charity Hospital, and Idlib University Hospital.

Undoubtedly, providing medical care effectively for these patients is tightly related to the status of medical devices in hospitals, as the malfunction of any device can negatively impact patients by causing them to wait for long periods to receive health care, leading to a deterioration of their health or even necessitating them to travel to areas far from their residence, and in some cases, this situation can lead to patient fatalities.

In the interview with him, the representative of the Idlib Health Directorate stated that the malfunction of medical devices leads to an increase in the rates of certain diseases, in addition to a rise in the number of fatalities. He has also said that delays in diagnosing diseases and patients having to wait for extended periods due to the lack of MRI or CT scanning devices can diminish the chances of patient recovery. As for the representative of Afrin Health Directorate, he stated that patients are compelled to wait for long periods to receive healthcare due to the malfunction of devices without any alternatives, such as the kidney stone lithotripsy device at Al-Shifa Hospital.

Regarding the malfunctioning devices that are of utmost priority for repair, the representative of Idlib Health Directorate said that these devices are CT scanners, MRI scanners, and dialysis machines, as there is a significant shortage of these devices in the region, and many are non-functional and lacking the necessary spare parts for maintenance. In Afrin, devices that are priority for repair include kidney stone lithotripsy devices, ophthalmic surgery devices, and endoscopic surgical equipment.

Managers of Healthcare facilities also affirmed that there are several types of devices that are a priority to repair due to their critical importance and the threat posed to patients' lives if left unrepaired, especially considering the absence of alternatives for some of these devices. Examples of such devices include the Ventricular Assist Device (VAD) used in open-heart surgeries, which is of paramount importance. Currently, there is only one such device present in the northwestern Syria region, located at Al-Hidaya Hospital in Harim, but it is currently non-functional. Additionally, it is of an essential importance to repair CT scanners, given the dire need for these devices as previously mentioned. There are five non-functional CT scanners, two of which at Atma Hospital and one at each of Al-Shifa Hospital, Jarabulus Hospital, and Jisr Al-Shughur Hospital. If repaired, these devices could potentially serve approximately

23,200 patients of all departments per month. The same applies to vacuum therapy devices, of which there are five inoperative devices that have no alternatives. The situation also holds true for Non-Invasive Blood Pressure (NIBP) devices.

In Al-Hikma Hospital in Ma'arat Misrin, the administrative director stated that their computerized eye examination device is non-functional and the whole region has no similar devices. As for Bone Drill devices, there are 15 malfunctioning devices at Aqarbat Hospital, and 4 at Bab Al-Hawa Hospital, these devices are used for surgical procedures, and no alternatives are available in the region. Repairing these devices could potentially provide care to around 1,600 patients per month.

On the other hand, the importance of some medical devices and the impact of their malfunction on the region can be inferred by considering the number of healthcare seekers and patients who can benefit from these devices if repaired, as according to the estimates of the hospitals' representatives, this number can reach about 656149 beneficiaries per month, this number is higher than the number of total patients visiting the hospital because each patient could benefit from the services of several devices when visiting the hospital. The number of beneficiaries of some types of devices is estimated at tens of thousands per month, and the following table shows a list of the types and numbers of some malfunctioning devices and the number of patients and healthcare seekers who may benefit from them per month if repaired:

Device Type	Number of malfunctioning devices	Number of potential beneficiaries per month in case devices are repaired
ECG	30	22450
ULTRASOUND DEVICE	32	24100
CENTERFUGE	21	55170
CHEMICAL ANALYZER DEVICE	13	41070
Air compressor	47	22405
Lab Hematology CBC device	15	44100
Lab microscopy	9	33000
Oxygen concentrator	37	36640
Radiology CT Scan device	5	23200
X Ray machine	11	17500
X-ray device	11	33150
Tosi device	3	8000
CR	2	5000
ABR Test device	1	4000
Slit lamp device	3	4000
Yag Laser device	1	4000
Argon Laser	1	4000
Opthalmic chart projector	2	4000
Beta CT scanner	1	2000

Device Maintenance

The maintenance of medical devices is very important to keep these devices in a safe and secure condition to allow using them without harm to patients or medical staff.

Maintenance operations contribute to increasing the lifespan of devices and improving their performance. Generally, there are two types of maintenance:

- A- Preventive maintenance:** carried out on a regular basis by checking medical devices periodically to ensure its efficiency and performance.
- B- Repair maintenance:** carried out in case of malfunctions, aiming to repair and reactivate devices.

As for hospitals and medical facilities in northwestern Syria, the findings of the field study showed that the highest percentage of them conduct periodic examination of their medical devices, and this examination is often conducted on a monthly or weekly basis. With regard to the reasons that hinder conducting periodic examination of devices, according to hospital representatives who said that they do not conduct this examination, these reasons include lack of specialized maintenance departments in the hospitals or lack of equipment necessary to conduct the examination, by 89% and 11%, respectively.

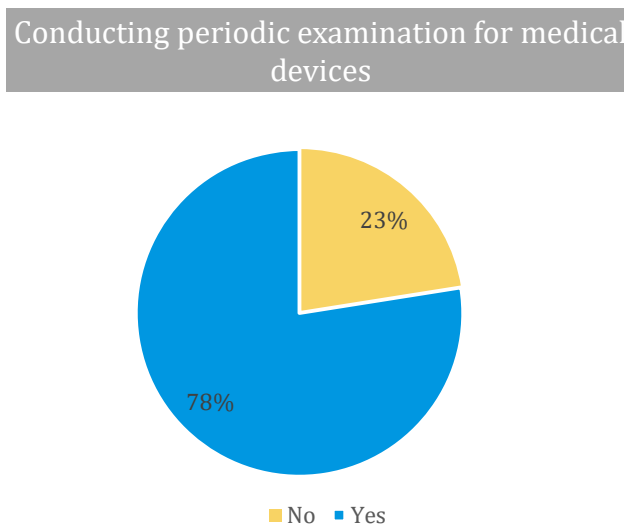


Figure 5 Conducting periodic examination for medical devices.

It is worth noting that more than half of the hospitals and medical facilities (55%) have no specialized maintenance departments according to the findings of field visits to these hospitals. This was also affirmed by representatives of the health directorates. In Afrin, the representative of the Directorate of Health said that public hospitals have no maintenance departments, and any necessary maintenance of devices is carried out by the sponsor organization that provided the device to the hospital or healthcare facility, while the Directorate of Health does not provide any device maintenance services. In Idlib, the representative of the Directorate of Health stated that hospitals generally have maintenance teams that are under the authority of the hospital or the operating entity, and the Directorate of Health also has a specialized maintenance team, although it is primarily a technical team and lacks the necessary equipment, thus lacking the ability to repair devices that need spare parts. It's worth mentioning

that the Directorate of Health used to have a comprehensive maintenance division, but lack of financial support caused cessation of its operations.

Repairing malfunctioning devices

First- Repairability of devices

Repairability of malfunctioning devices is subject to several factors, including the type of the malfunction, the type of device, and its model. The type of malfunction has a crucial role in the possibility of repairing the device. The maintenance expert in Idlib stated that simple mechanical malfunctions are easy to repair, as are certain damaged components, because spare parts can be brought and installed. However, modern circuit boards and old-model devices are irreparable due to the difficulty of finding spare parts because they are no longer produced by the manufacturing company that might even be closed.

Maintenance experts in Aleppo stated that all types of malfunctions, whether electrical, electronic, mechanical, or software-related, can be repaired. However, one of the experts said that some malfunctions in old-model devices are irreparable, where the malfunction happened because the device has reached the end of its lifespan. Some devices are difficult to repair due to unknown or uncommon device models. Furthermore, some poor-quality devices, often imported from China, are not worth repairing due to the high repair cost, which can sometimes be equal to the price of a new device.

The representative of the Directorate of Health in Idlib also highlighted a range of malfunctions that are difficult to repair, including electronic circuit failures due to the unavailability of spare parts, as well as the cessation of circuit manufacturing in the country of origin. Even if available, the cost of repair is significantly high, making it unfeasible for organizations to cover these expenses due to lack of sufficient budget. The representative of the Directorate of Health in Aleppo stated that mechanical malfunctions are among the most challenging to repair due to the lack of spare parts in the local market, whether new or second-hand, and due to the difficulty of importing these parts from other countries.

Referring back to the findings of the field survey, we find that the percentage of repairable medical devices is high as stated by representatives of healthcare facilities and hospitals, as this percentage reached 81%.

Is the malfunctioning device repairable?

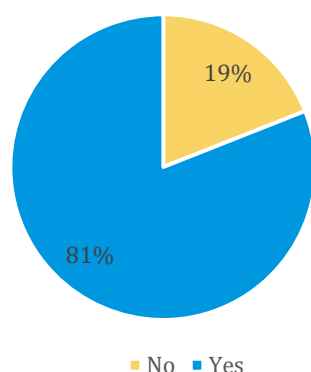


Figure 6 The ability to device repairable

Second- Obstacles hindering repair of medical devices:

Despite the large number of repairable devices, a significant portion of them have been non-functional for a year or more. Regarding the reasons that hinder their repair, hospitals' representatives attributed this primarily to the high cost of maintenance, followed by lack of spare parts necessary for device repair and the absence of entities that support hospitals and medical facilities to conduct repair operations. It is important to denote that representatives of Health Directorates in both Idlib and Aleppo emphasized the absence of any organizations or entities that provide support, neither technical nor financial, for the repair of malfunctioning devices, and the efforts of organization that support the hospitals are limited to repairing the device if they have a specialized maintenance department and if the required spare parts are available.

If the device is repairable, why isn't it repaired?

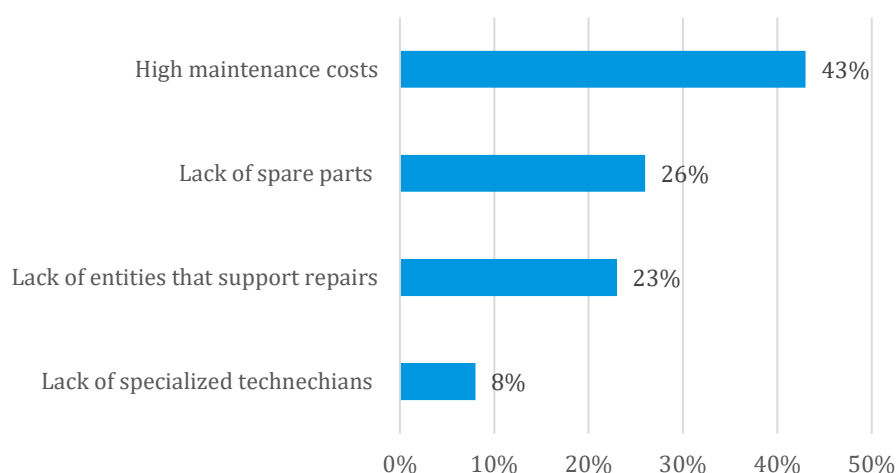


Figure 7 Reason for not repairing.

Maintenance experts and representatives of health directorates also affirmed these obstacles. In Idlib, the maintenance expert stated that the most significant obstacles they face, which impede their ability to repair malfunctioning devices include the unavailability of spare parts in the local market, in addition to the lack of necessary equipment such as calibration and measurement tools. Additionally, there is a deficiency in expertise in handling certain types of devices. This is compounded by limited financial resources and the absence of entities that support the maintenance and repair of medical devices. The expert has also stated that the Idlib Health Directorate had a maintenance department responsible for repairing medical devices in hospitals and healthcare facilities, however, this department was shut down due to cessation of funding.

Maintenance experts in Aleppo have also emphasized financial obstacles as one of the most prominent obstacles to repairing malfunctioning devices, as maintenance and repair costs are often high and are higher than the amounts allocated for maintenance in the budgets of supporting organizations. One of the experts added the lack of spare parts in the local market as an obstacle to repairing devices, and therefore, they have to contact the manufacturer to provide the required parts, but these companies do not respond to them sometimes or there is difficulty in delivering the required parts to northern Syria, and the difficulty of obtaining spare parts increases in light of the great diversity of types of malfunctioning devices and the presence of devices of unknown model or brand.

The shortage in the number of medical devices maintenance specialists and workshops is also among the prominent challenges that hinder repairing malfunctioning devices, as for maintenance workshops, the representative of the Directorate of Health in Aleppo says that they are limited to workshops that can repair electrical malfunctions, and there are a few experienced engineers in the region who are contacted in the event of a malfunction in a device to carry out the examination and repair process, while the representative of the Directorate of Health in Idlib said that there are some maintenance workshops, however, its staff are not highly qualified and need more qualification and training.

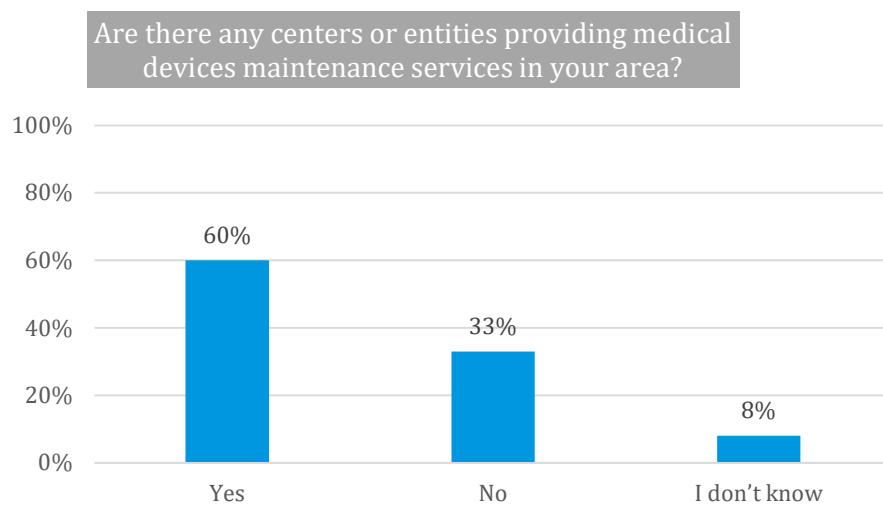


Figure 8 Availability of centers or agencies that provide maintenance services for medical devices in the region.

Representatives of healthcare facilities and hospitals affirmed facing these challenges again when they were asked about how do they handle malfunctioning devices, as their answers included that they try to repair them first, and if they cannot repair them, they are placed in warehouses, re-sent to the supporting entity, or they send them to the health directorates in their regions. In general, the percentage of devices that underwent repair attempts was very high, but the majority of these attempts were in vain, either due to the high costs of repair, lack of required spare parts, lack of technicians specialized in dealing with certain types of devices, or the end of the lifespan of the device, which makes repairing it unavailing.

Have you attempted repairing non-functional medical devices?

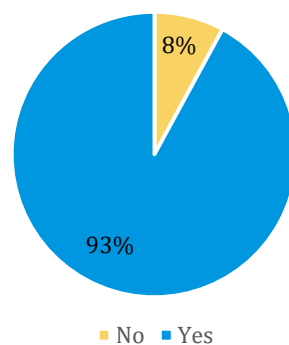


Figure 9 Attempts to repair non-functional medical devices.

In order for the hospitals and healthcare facilities to overcome the aforementioned obstacles and become able to repair medical devices, they need to receive several forms of support, the most important of which, from the point of view of hospital representatives, are providing spare parts to replace damaged ones, and providing qualified technicians specialized in repairing medical devices, in addition to supporting hospitals with repair costs.

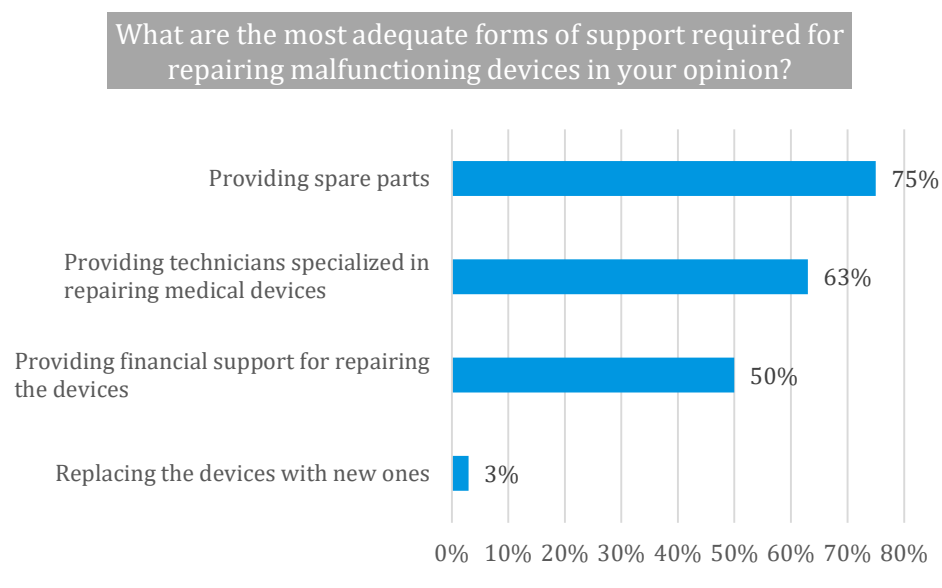


Figure 10 forms of support required for repairing malfunctioning devices.

Types of Malfunctions

The malfunctions of medical devices are of several types, and caused by several reasons. With regard to the most common types of malfunctions, maintenance experts said that they include mechanical and electrical malfunctions in the first place, followed by software and electronic malfunctions, while the representative of the Directorate of Health in Idlib said that malfunctions of medical devices often include the malfunctions of electrical circuits or boards. These statements are consistent with the findings of the field survey in hospitals, as the majority of device malfunctions are mechanical or electrical, followed by programming malfunctions, in addition to malfunctions related to the obsolescence of the device parts and components. The representative of the Directorate of Health in Aleppo stressed that medical devices are prone to all types of malfunctions, whether mechanical, electrical, electronic or software-related, however, he listed some types of devices that are more prone to malfunctions, which encompass the devices used in the operations rooms, radiology devices and analysis devices used in laboratories.

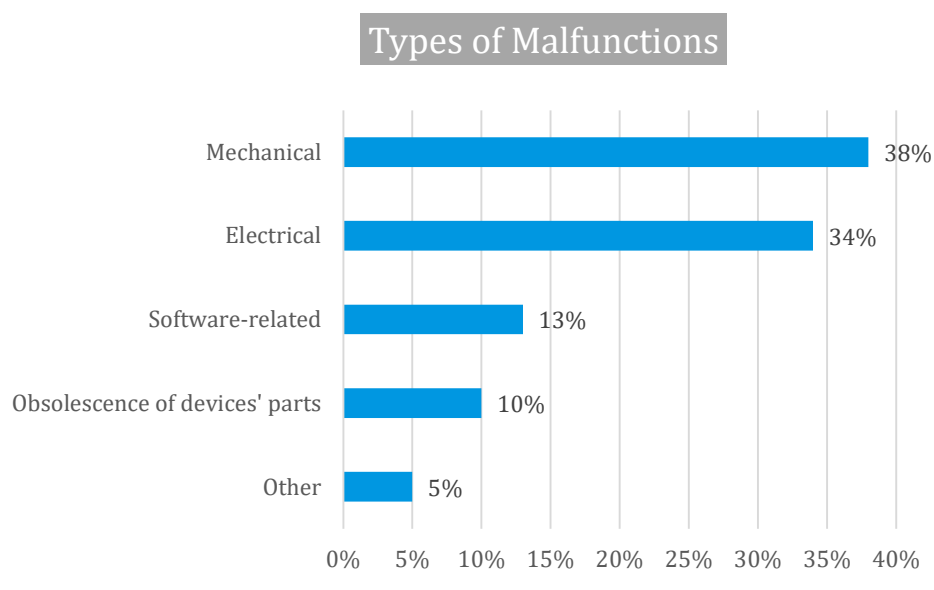


Figure 11 Types of Malfunctions

Note: (The option OTHER mainly includes the end of the device's lifespan and the answer stating lack of knowledge of the type of malfunction.)

Regarding the reasons causing malfunctions, maintenance experts and representatives of health directorates listed several reasons, primarily as follows:

- A- The end of the lifespan of the devices, which causes frequent malfunctions, noting that many of the devices in medical facilities in northwestern Syria were second-hand devices, as they were used before they were donated to medical facilities.
- B- Many malfunctions are caused by unstable electricity feed that devices receive, and this is because electricity in the area is generally unstable.
- C- Misuse of devices, which is due to lack of trained and qualified staff to operate some types of medical devices.

Representatives of healthcare facilities emphasized that the misuse of devices is one of the most prominent reasons that cause malfunctions, as many malfunctions resulted from mistakes of the staff of the hospital in operating the device, and 30% of hospital representatives say that their staff need to receive training on how to operate some types of devices.

Are there any cases where malfunctions were caused by staff mistakes in operating the device?

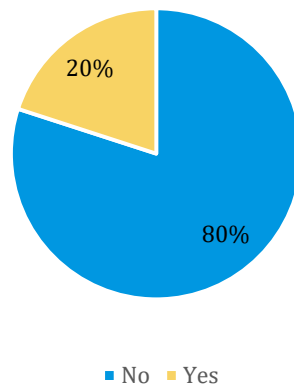


Figure 12 Cases of breakdowns caused by employee errors.

Availability of spare parts

Due to the significant role of spare parts in the process of repairing medical devices, as they constitute a key requirement for such operations, it was essential to inquire about their availability in the northwestern regions of Syria. Representatives of health directorates and maintenance experts stated that the region suffers from a severe shortage and scarcity of spare parts, which hampers the ability to repair malfunctioning devices within healthcare facilities and hospitals.

The representative of Idlib Health Directorate stated that spare parts are generally not widely available in Northwestern Syria, and most of the available parts are imported from neighboring market in Turkey, and they can also be obtained through contacting the device's manufacturer (if they respond), knowing that these parts are of significantly high prices. Furthermore, it's not feasible to verify the integrity of the required parts before importing it, knowing that electronic components are among the most difficult parts to procure.

The maintenance expert in Idlib stated that the availability of spare parts depends on the type and model of the device, as spare parts of some devices are utterly unavailable. These devices primarily include old-model devices for which the manufacturing company has ceased producing spare parts. He also added that even for devices for which spare parts can be found, the quantities available are insufficient to meet the demand due to the extremely high demand for spare parts, as the devices of healthcare facilities are mostly donated and second-hand devices, making its malfunctions more frequent.

Regarding the sources of spare parts available in the market, the expert said that they are predominantly imported by private companies or removed from irreparable devices, and in rare cases of mechanical malfunctions, some simple spare parts are manufactured in lathing workshops or using CNC machines.

In Aleppo, maintenance experts said that spare parts are well available, as all types of spare parts can be imported from Turkey and the rest of the world, except for spare parts for old-model devices, which are no longer produced by their manufacturers, and on the other hand, some spare parts such as mechanical parts and gears are being locally manufactured.

For their part, representatives of healthcare facilities and hospitals emphasized the difficulty of obtaining spare parts, as about half of them said that spare parts are available at low or very low extent as shown in the chart below.

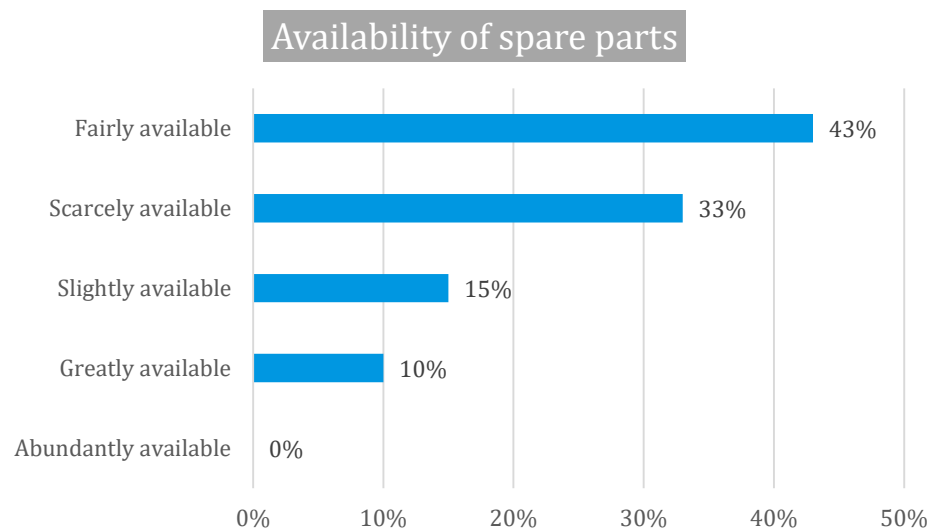


Figure 13 Availability of spare parts

It should also be noted that all study participants confirmed that there is no ability to produce spare parts to repair software system malfunctions locally, and that local manufacturing is limited to simple spare parts that are often used to repair mechanical or electronic malfunctions, such as electronic circuits, gears, and mechanical components, and these parts are often manufactured in lathing workshops, as there are no laboratories or centers specialized in manufacturing operations, according to all study participants, except for one maintenance expert in Aleppo who said that there are some centers that manufacture spare parts for malfunctioning devices, but these centers are scarce.

Maintenance experts and representatives of health directorates believe that it is possible to establish workshops or centers for manufacturing spare parts locally, and they listed several requirements needed to achieve this endeavor, including the necessity of obtaining the required legal permits, providing equipment, and training a specialized staff consisting of engineers, medical devices technicians, mechanics, electricians, and programmers.

However, establishing such workshops or centers could face some challenges and obstacles, such as the high establishment and operation costs that include prices of equipment and tools, in addition to the high prices of raw materials. Furthermore, it is impossible to manufacture some types of spare parts, especially those used for

repairing programming malfunctions because the manufacturers of medical devices are the only producers of such parts and components. Moreover, the significant diversity in types and models of medical devices is one of the obstacles that must be taken into consideration. In addition to the foregoing challenges, the region lacks technical specialists capable of manufacturing these parts, nonetheless, this issue can be solved by launching training courses in the field of repairing medical devices to qualify some of university graduates from the area.

Recycling Malfunctioning Devices

According to the formerly discussed findings of the study, there is a significant number of malfunctioning medical devices of the same type, and these devices are located in various hospitals, knowing that some of these devices are irreparable. Based on the foregoing, the parts and components of these devices can be utilized as spare parts for repairing other malfunctioning devices. This requires coordination between healthcare facilities and hospitals, and also requires the willingness and ability of these facilities to exchange parts and components of malfunctioning devices. Also, the effectiveness of this endeavor would be amplified by the presence of an entity or an organization that assumes coordinating between healthcare facilities and preparing lists and databases detailing the types and quantities of devices that medical facilities can share so that other healthcare facilities or hospitals can benefit from its components.

Notably, a high percentage of the surveyed healthcare facilities and hospitals have expressed willingness to share irreparable medical device components with other healthcare facilities or any relevant entities that could utilize these components to repair malfunctioning medical devices in other healthcare facilities or hospitals. However, some representatives of healthcare facilities have indicated an inability to share such components because these devices are property of the supporting organization or the donor that provided the device to the hospital, therefore, these devices cannot be utilized without obtaining official consent from the supporting organization or the donor, and if such consent is obtained, they have no problem with sharing the devices and components.

Is your healthcare facility willing to share components of irreparable devices?

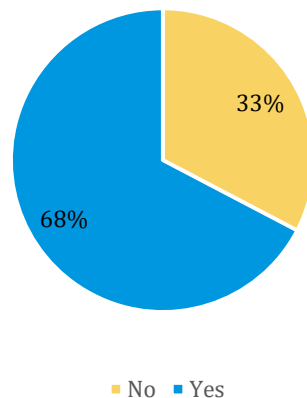


Figure 14 Prepare to share irreparable hardware components.

In fact, some healthcare facilities and hospitals are already coordinating with each other to exchange spare parts for irreparable medical devices to be used in repairing and reactivating malfunctioning devices, such coordination is mostly conducted through organizations supporting the hospital, and the Turkish government is also coordinating some of these coordination efforts.

Is there a coordination between healthcare facilities to exchange components of malfunctioning devices?

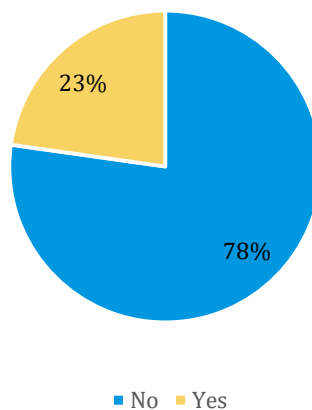


Figure 15 Prepare to share irreparable hardware components.

Representatives of the Health Directorates in both Aleppo and Idlib have expressed their support for the proposal of exchanging spare parts among different healthcare facilities and hospitals. They believe that such an initiative could help overcome the issue of unavailability of spare parts. Additionally, they emphasized the importance of having a center responsible for coordination activities between healthcare

establishments and hospitals. This coordinating center, if established, can operate under the supervision of the Health Directorates, as current coordination efforts (if any) are merely individual initiatives by hospitals or their operating organizations, while the current role of the Health Directorates is limited to receiving information about malfunctioning devices from healthcare facilities, whereas in the event of a device malfunction, the hospital sends a letter to the Health Directorate detailing the type of device, its function, the department in which it's used, and the nature of the malfunction. It is worth noting that the representative from the Health Directorate in Idlib mentioned that the directorate (before shutting down its maintenance division) used to dispatch a maintenance team to the hospital upon receiving a report of device malfunction, and this team would then provide a comprehensive report about the device's status and repairability, so that it can be repaired.

For their part, the vast majority of representatives of healthcare facilities confirmed their willingness to cooperate and coordinate with any center or office that would be established to coordinate between hospitals and healthcare facilities, and those who said that they cannot coordinate with such an office or center attributed this to the need to obtain the consent of the organization supporting the hospital or the donor.

Is your facility willing to coordinate with a center that would coordinate between healthcare facilities?

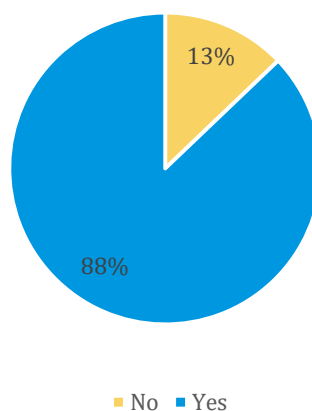


Figure 16 Coordination of healthcare facilities

E-waste

E-waste encompasses all old-model irreparable electrical or electronic devices. It also includes components and remnants of dismantled devices, such as batteries, electronic circuits, electrical components, cables, leaded capacitors, and other components.

E-waste represents a highly valuable resource, as a significant portion of it can be recycled, while unrecyclable components are properly disposed of. It is important to emphasize that the process of disposing of E-waste from hospitals and healthcare facilities requires secure and technical treatment before disposal, due to the toxic materials present in some devices that can pose risks to health and environment.

The process of E-waste recycling should also adhere to a technically secure approach, as it involves risks to people involved in recycling operations, as well as to the environment and public health. Therefore, official E-waste recycling operations usually require establishing specialized facilities equipped with appropriate equipment for the safe extraction of repairable materials while ensuring safe and healthy working conditions. However, establishing and operating such facilities requires high costs, the thing that hinders establishing such facilities in less developed countries.¹³

The process of E-waste recycling can lead to direct or indirect exposure to a variety of hazardous substances resulting from unsafe recycling practices, for example, there is mostly an inadequate treatment of gases emitted during the recycling process, as plastic covers are often burnt or melted to retrieve metals from electronic chips and other components, which releases heavy metals like lead, cadmium, and mercury. Inhaling these gases can result in severe health damages. Additionally, the chemicals used in primitive recycling methods are harmful; as they include substances like cyanide and organic solvents.¹⁴

Hazardous recycling materials can spread over long distances and persist in the environment for extended periods, thus carrying long-term and wide-ranging health risks, these materials also leak into soil and water, leading to health repercussions such as lung function changes, mental health issues, cancer-causing effects, disruption of endocrine glands, and neural growth deformities.

The above underscores the necessity of handling non-repairable medical equipment waste in hospitals and healthcare facilities in northwestern Syria with caution, and emphasizes the importance of creating safe technological conditions for E-waste recycling, which requires launching awareness campaigns for personnel in hospitals, healthcare facilities, and medical device maintenance workers about the risks of primitive recycling methods and introducing the mechanisms of proper and secure recycling operations.

¹³ Tapiwa Nxele, Peter Sly, E-waste: A global hazard, *Annals of Global Health*, November 2014, P 290. [\(PDF\) E-waste: A global hazard \(researchgate.net\)](#)

¹⁴ Ibid., p. 288

Appendix A (List of Hospitals and Healthcare Centers)

	Healthcare Facility	Location	Specialization
1	Al, Iman Hospital	Idlib - Sarmada	Gynecology & Pediatrics
2	Al-Madina Gynecology & Pediatrics hospital	Idlib – Kalli	Gynecology & Pediatrics
3	Al-Ra'i Hospital	Aleppo - Al-Ra'i	General Hospital
4	Jarablus Hospital	Aleppo – Jarablus	General Hospital
5	Waseem Hussein Hospital	Idlib - Kafr Takharim	Surgical Hospital
6	Al-Amal Hospital	Idlib - Salqin	Orthopedic Hospital
7	Obstetrics Hospital	Idlib - Kafr Takharim	Gynecology & Pediatrics
8	Al-Salam Hospital	Idlib – Harem	Gynecology & Pediatrics
9	Jisr Al-Shughour Surgical Hospital	Idlib – Jisr Al-Shughour	Surgical – Pediatrics – Gynecology
10	Idlib Surgical Hospital	Idlib City	Surgical Hospital
11	Al-Qiniyah Hospital	Idlib - Al- Qiniyah	Surgical – Gynecology – Pediatrics
12	Al-Noor Hospital	Idlib - Taftanaz	Gynecology & Pediatrics
13	Binnish Surgical Hospital	Idlib - Binnish	General Hospital
14	Al-Shughour Specialized Hospital	Idlib – Jisr Al-Shughour	Abdominal Medicine Hospital
15	Harem General Hospital	Idlib - Harem	General Hospital
16	Raju Gynecology & Pediatrics Hospital	Aleppo - Raju	Gynecology & Pediatrics
17	Sajjo Hospital	Aleppo - Azaz	Gynecology & Pediatrics
18	Blood Bank	Aleppo - Afrin	Thalassemia Treatment Center – Blood Bank
19	Jindires Surgical Hospital	Aleppo - Jindires	Surgical Hospital
20	Al Hakim Medical Center	Aleppo - Afrin	Primary Care Center (Outpatient center)
21	Idlib University Hospital	Idlib – Idlib City	General Hospital
22	Ariha Central Hospital	Idlib - Ariha	General Hospital
23	Al-Hikma Hospital	Idlib – Kafr Yahmoul	Ophthalmiatrics - Otolaryngology
24	Al-Shifa' Hospital	Idlib – Idlib City	General Hospital
25	Al-Ferdous Hospital	Aleppo – Darat Azza	Gynecology & Pediatrics
26	Al-Kenana Hospital	Aleppo – Darat Azza	Surgical Hospital
27	Aqrabat Hospital	Idlib - Aqrabat	Osteopathic Hospital
28	Alhedaya Hospital	Idlib – Qah	General Hospital
29	Bab Al-Hawa Hospital	Idlib – Bab Al-Hawa	General Hospital
30	Atmeh Charity Hospital	Idlib - Atmeh	General Hospital
31	Dialysis Center	Idlib – Idlib City	Dialysis Center
32	Al-Shifa' Hospital	Aleppo - Afrin	General – Gynecology & Pediatrics
33	Al Mahaba Hospital	Aleppo - Afrin	Gynecology & Pediatrics
34	Martyr Mohammed Walid Moaz Hospital	Aleppo - Sajjo	Primary Care Center (Outpatient Center)
35	Al-Andalus Hospital	Aleppo - Batbu	Surgical – Gynecology – Pediatrics
36	Azaz National Hospital	Aleppo - Azaz	General Hospital
37	Al-Amal Hospital	Aleppo - Azaz	Gynecology & Pediatrics
38	Gynecology & Pediatrics Hospital	Aleppo - Azaz	Gynecology & Pediatrics
39	Al-Zahrawi Hospital	Idlib – Idlib City	Gynecology & Pediatrics
40	Idlib National Hospital	Idlib – Idlib City	Abdominal medicine hospital

Appendix B (Types of Malfunctioning Medical Devices)

Type of the device	Number of malfunctioning devices in hospitals
Medical gypsum fracture device	7
Dermojet Injection	7
Infant Incubator	6
UPS device	6
Radiology CT Scan device	5
Vaccum Therapy	5
Ventilator	5
V Scan Device	5
ABG Blood Gas Analyzer	5
NIBP DEVICE	5
LAPAROSCOPIC INSTRUMENT	5
CR	5
ICU ventilator	4
Neonatal intensive care unit (submarine)	4
Cavetron	3
Sterilizer	3
Surgery Microscope	3
Exposed incubator	3
ICU beds	3
Slit lamp device	3
Tosi device	3
Pocket fetal doppler	3
INFANT HEAT RADIATOR-MOBILE	2
PATIENT STRESS TEST DEVICE	2
Double G urine extractor	2
Scale	2
Lab centrifuges	2
Ophthalmic chart projector	2
Ophthalmic Phacoemulsification	2
Endoscopy scope for the Colon	2
Endoscopy tower + pressor	2
C – arm machine	2
Desalination system	2
Dental clinic chair	2
Auto eye test device	1
Baby pulse reader	1
Infant warmer	1
Endoscopic therapy device used in gastrointestinal endoscopy	1
C-Arm machine	1
Ear check device	1
Mobile Operations Light	1
CTJ	1
Lab chemical device	1
Beta CT Scanner	2
Gastrointestinal endoscopy screen	1
X-ray development device	1
Plasma freezer	1
C-ARM machine	1
Fluoroscopy device	1

Maxillofacial Surgery Chair	1
Endoscopy device	2
ABR Test device	1
Cardiopulmonary bypass	1
Orthopedic surgery table	1
Wireless DR	1
Dry sterilizer	1
Cardiac catheterization	1
Lens measuring device	1
Mammography device	1
Gastroscopic scope	1
Endoscopy camera and lens	1
Upper gastrointestinal endoscopy device	1
ERCP endoscope	1
Dermatome	1
Argon Laser	1
Argon optical device	1
Colon endoscope	1
YAG Laser	1
Light source	1
Uterine polyps removal	1
O2 Generator	1

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