

Chapter 17

General Oncology Care in Syria



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17.1 Syria Demography

Syria is a country in the Middle East located at the eastern end of the Mediterranean Sea. Historically, it has been home to some of the world's oldest civilizations, with a rich scientific, artistic, and cultural heritage. The capital city, Damascus, is thought to be the oldest continuously inhabited city in the world. As such, Syria has often been described as the largest small country in the world owing to the depth of its history and wealth of culture [1].

The modern Syrian state was officially established as a parliamentary republic on 24 October 1945. It became a founding member of the United Nations. It has a total area of 185,180 km² consisting of 14 governorates including Damascus (~1.7 million inhabitants; Greater Damascus: four million inhabitants) [2], Aleppo (also one of the oldest continuously inhabited cities), Damascus, Rif Dimashq, Homs, Hama, Latakia, Deir ez-Zor, Ar Raqqa, Idlib, Hasakah, As-Suwayda, Daraa, Quneitra, and Tartus. The population of Syria in 2020 was estimated at 17,500,658 people.

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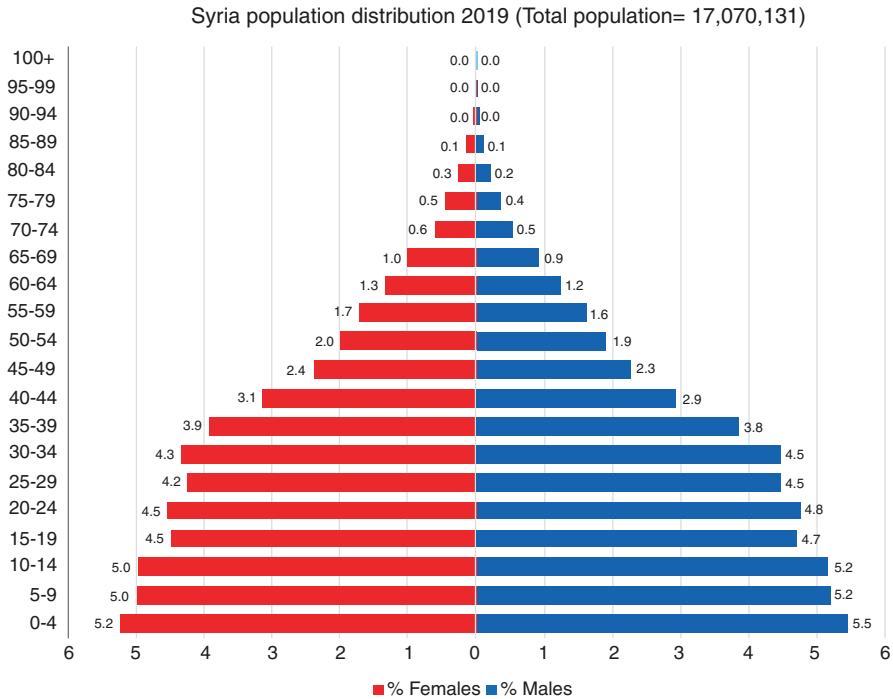


Fig. 17.1 Gender (male and female) distribution by age in the Syrian Arab Republic in the year 2019 [36]. Reproduced from the source “PopulationPyramid.net” (accessed on 09/08/2021; URL link: <https://www.populationpyramid.net/syrian-arab-republic/2019/>)

The population density is 95 per km² (247 people per mi²) and 60% of the population is urban. Total Fertility Rate (TFR) is 2.8 (Live Births per Woman, 2020). Life expectancy at birth is 76.06 years, female 79.1 years, male 73.1 years. Infant Mortality Rate is 11.3 (infant deaths per 1000 live births) [34], while gender ratio is 50.1% male and 49.9% female (Fig. 17.1) [35, 36].

In the early 2000s, Syria embarked on a gradual economic liberalization to spur growth. However, 10 years of tragic conflict has set the country back in terms of economic, social, and human development. The economy has contracted by more than 50% in real terms since 2011 such that Syria’s Gross Domestic Product (GDP) is less than half of what it was before the war started [3, 37]. During the conflict, five to six million people, out of a pre-war population of 22 million, were displaced from Syria [4, 5].

17.2 Cancer Statistics in Syria

The Syrian National Cancer Registry (SNCR) is a hospital-based registry that was established in 2001 to define the population-based incidence in Syria and provide knowledge about the extent of cancer burden, epidemiology, early detection, and

cancer screening. The SNCR has been awarded associate membership to the International Association of Cancer Registries (IACR). CanReg 5 was introduced by the World Health Organization (WHO) in 2020 as an open source tool to input, store, check, and analyse cancer registry data.

According to the SNCR, the estimated cancer statistics before the beginning of the conflict in 2011, were 17,599 new cases in 2009 (total population = 21,092,000). Of those, 9213 (52%) were males and 8386 (48%) were females. The 2009 Cancer Registry shows that in males, the most frequent cancer site was the lungs (17%), followed by colon and rectum (12%) and leukaemia (10%). While in females, the most frequent cancer sites were breast (30%), colon and rectum (11%), and leukaemia (8%) (Fig. 17.2). The Age Standardized Rate (ASR) for all cancer cases combined was 128 per 100,000 for males and 117 per 100,000 for females. The cure rate is approximately 40%. Estimated mortality rate for cancer was 52 and 76 per 100,000 for females and males in 2009 [12, 38]. With about 1700 new paediatric cases, the most common types of cancer among children (0–15 years old), for boys and girls, respectively, are: leukaemia (37–34%), brain and CNS (20–22%), lymphoma (17–14%), bones and soft tissue (12–13%), kidney and other endocrine (7–6%), and all other sites (7–11%). Cancer is the third most common cause of death in Syria [12, 38].

The post-war statistical data is suboptimal for a number of reasons including the displacement of five million people outside the country. However, it was noted that cancer cases have been increasing in Syria according to the Al Bairouni 2020

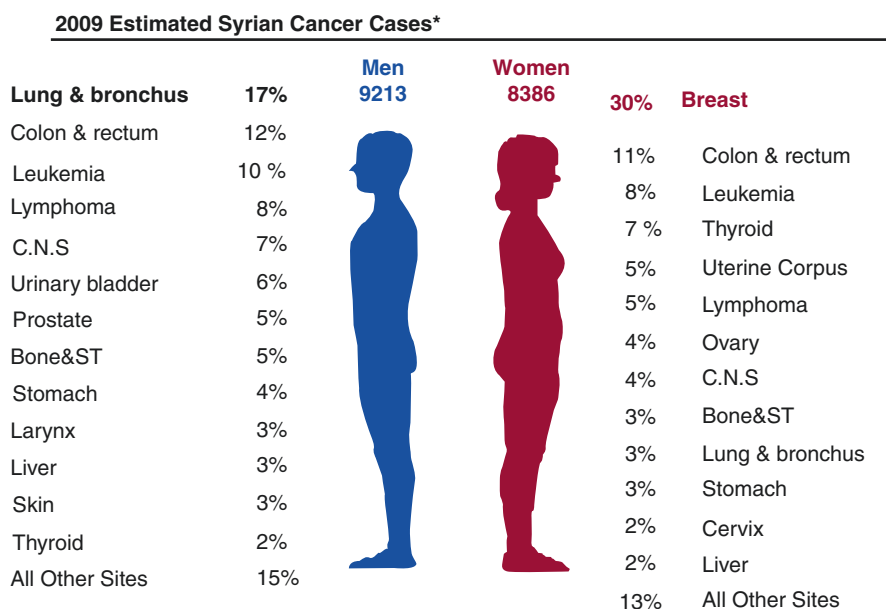


Fig. 17.2 Cancer incidence rate between male and female in Syria with most common cancers in 2009 [12, 38]. Source: Syrian National Cancer Registry, 2009 (Partially developed). Used with permission from Firas AL Jerf

Table 17.1 Percentage of each site of adult cancers in both genders at Al Bairouni University Hospital, 2020. Used with permission from Al Bairouni University Hospital

Coding (IARC.WHO) ICD-10	Percentage (%)	Total	Topography	Rank
C50	24.36	2067	Breast	1
C34	9.75	827	Lung, bronchus, trachea	3
C73	8.31	705	Thyroid	2
C18-C20	7.42	630	Colon and rectum	4
C85	4.68	397	Lymphoma	7
C40-C49	4.53	384	Bone and soft tissue	6
C53 + C55	4.17	354	Cervix and uterus	18
C71	3.92	333	Brain and CNS	8
C67	3.32	282	Bladder	9
C56	2.83	240	Ovary	14
C16	2.75	233	Stomach	13
C61	2.59	220	Prostate	10
C42	2.42	205	Leukaemia	5
C32	1.81	154	Larynx	12
C25	1.36	115	Pancreas	17
C22	1.20	102	Liver	21
C64	1.18	100	Kidney	15
C62	0.95	81	Testis	19

hospital-based registry data, the hospital sees more than 60% of Syrian cancer patients. The detailed cancer sites are shown in Table 17.1, which refers to the most common cancers at Al Bairouni, i.e. breast 24%, lung 10%, thyroid 8%, colorectal 7%, lymphoma 5%. The high number of thyroid cancers is because Al Bairouni Hospital is the only treatment centre that manages thyroid cancers in all of Syria.

There were about 9000 annual new cases in Al Bairouni University Hospital in the year 2020, of which 3960 were male (44%) and 5040 were female patients (56%). The most frequent cancer sites in both genders are breast 24%, head and neck 22%, genitourinary tract 15%, GI 15%, haematological malignancies 10%, and lung cancers 10% (Fig. 17.3).

The GLOBOCAN statistics for 2020 described the number of new cases in both sexes, all ages, where breast (20.9%), lung (9.4%), colorectal (8.4%), prostate (5.2%), and NHL (4.8%) are at the top [39].

The most frequent paediatric cancers prevalent at Al Bairouni University Hospital are CNS, leukaemia, lymphoma, bone and soft tissue sarcoma, and kidney.

Estimated cancer incidences among Syrian refugees is shown by a study written in Lancet 2020 with R4HC-MENA collaboration, describing the cancer incidence, cost of treatment among Syrian refugees in Lebanon [13].

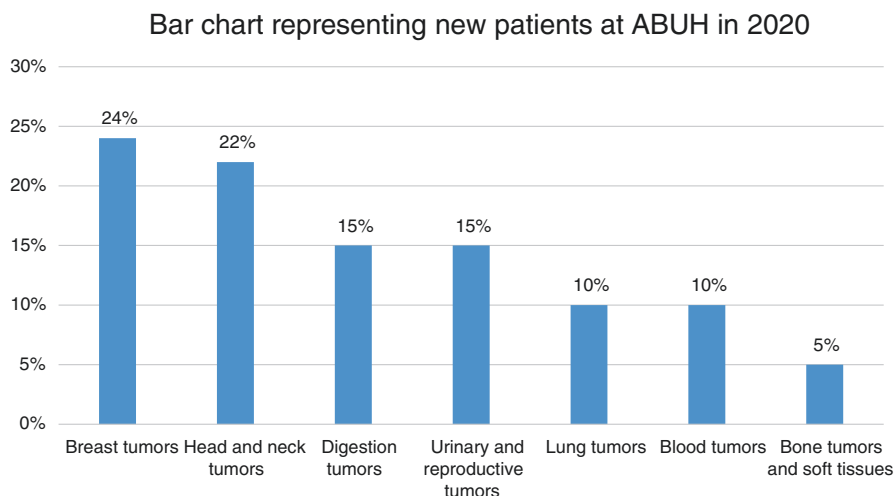


Fig. 17.3 Most common adult cancers in both genders at Al Bairouni University Hospital in 2020. Used with permission from Al Bairouni University Hospital

17.3 Healthcare System in Syria

Healthcare system is based on a collaboration between public and private sectors. Health and social services are the responsibilities of the government with Ministry of Health coverage in collaboration with partners of medical corps to provide quality health care with equity (rural populations achieving better equity than before) and sustainability [6]. The role played by the private sector has increased in many ways including patients' own pocket, Social Health Insurance (SHI) schemes, and Public-Private Partnership (PPP). Additionally, civil societies and WHO support play an important role. Health expenditures accounted for 3.3% of GDP in 2014, while the total pharmaceutical expenditure accounts for 1.11% of the GDP [7].

The top three diseases that cause mortality in Syria are: cardiovascular diseases (44.72%), respiratory diseases (16.2%), and tumours (7.0%). While diseases causing morbidity are digestive, respiratory and cardiovascular diseases, poisoning, injuries, infections, and parasitic diseases followed by cancer and kidney diseases (Table 17.2) [9].

In the early 2000s, Syria could credit itself with improved living standards, awareness of health issues, strengthened by improvements to infrastructure, access to clean water, expanding public healthcare systems and local production of >90% of medicines (despite past economic pressures and isolation). The integration of healthcare has been a significant factor for the country to be on target with health Millennium Development Goals (MDGs) [8].

Table 17.2 Top ten causes of mortality and morbidity in the Republic of Syria—2009 [9]

Rank mortality	Morbidity/disability	
1	Cardiovascular diseases	Digestive diseases
2	Respiratory diseases	Respiratory diseases
3	Cancer	Cardiovascular diseases
4	Injuries	Poisoning
5	Certain conditions originating in the P-natal period	Injuries
6	Genitourinary diseases	Infectious and parasitic diseases
7	Congenital malformations, deformations, and chromosomal abnormalities	Cancer
8	Nervous diseases	Kidney diseases
9	Digestive diseases	Blood diseases
10	Endocrine, nutritional, and metabolic diseases	Certain conditions originating in the prenatal period

Source: MOH Syrian Arab Republic 2010. Used with permission from Rajwa Jubaili

Human resources for health in Syria described according to 2010 Ministry of Health (MOH) data, there are 17,300 (8.1/10,000) licensed pharmacists, 31,194 (14.6/10,000) physicians, and 40,053 (18.8/10,000) nursing and midwifery personnel. The ratio of doctors to pharmacists is 1.8 and the ratio of doctors to nurses and midwifery personnel is 0.8. The average of total hospitals according to 2010 data was 482 with 30,206 beds, 117 public hospitals (21,849 bed) covering 65% of the country's capacity. There are 70 licensed pharmaceutical manufacturers in Syria, domestic manufacturers hold 91% of the market share by value produced [9].

Since the 2011 conflict, Syria faced inhumane economic sanctions with severe consequences on health care. Sanctions have prevented the entry of essential medical supplies into the country, including those for cancer treatment which are not produced locally, as well as preventing spare parts for medical machines hence preventing repair of essential hospital equipment. The pharmaceutical sector which suffered significant destruction is now rebuilding and gearing up to reach its pre-conflict productivity. A survey conducted by HRAMS WHO about war destruction for health services showed that 47% of public health centres were reported fully functioning, 22% partially functioning, and 31% non-functioning (completely out of service) [10].

17.4 Oncology Care in Syria

Despite war strain, COVID-19 pandemic, and global cancer burden, the Syrian government continues to provide free cancer services to all patients with less than 10% involvement of private sector, insurance companies, and charitable civil societies.

Al Bairouni University Hospital (ABUH) for cancer treatment in Damascus is a comprehensive specialized referral hospital (550 beds) that recruits about 60% of cancer patients (annual new cases 11,000). All types of cancer treatments including chemotherapy, targeted therapy as well as radiation oncology are provided as standard of care. The exception is bone marrow transplant. For the time being, cancer registry statistics are ABUH-based.

At least 15 more oncology centres provide cancer treatment in different governorates. Tishreen University Hospital in Latakia is the second most comprehensive centre with 3000 new cancer cases annually. Whereas Al Kindi University Hospital in Aleppo is currently being re-established aiming to deliver a high standard of care in the north of Syria.

Figure 17.4 shows the distribution of public hospitals that provide cancer care services in Syria [11].

The rapid progress and promising developments in oncology care in Syria were interrupted by the conflict with effects including shortage of drugs and availability of specialized medical equipment. Collaborating with WHO and allied countries, alongside starting local cancer drugs production in near future will hopefully enhance the country's cancer care services.

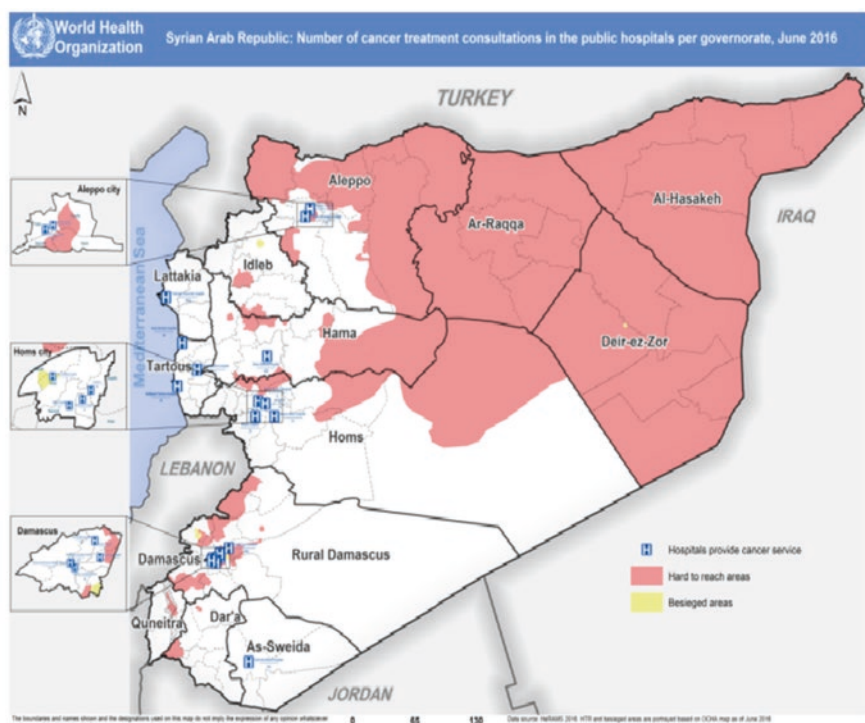


Fig. 17.4 Distribution of public hospitals that provide cancer treatment services [11]. Used with permission from Firas AL Jerf

The Syrian National Cancer Control Committee (NCCC) was established in June 2019, with the objective of coordinating cancer care between all oncology services and hence significantly improving oncology care across all of Syria. Ultimately, the aim is to build more comprehensive centres covering the middle, east, and north part of the country in order to deliver satisfactory cancer care with unified oncology practice guidelines that will diminish heterogeneity in oncology practice.

17.5 Cancer Risk Factors

Syria is undergoing an epidemiological transition in healthcare burden from communicable to non-communicable diseases (NCDs) [14]. NCDs were estimated to account for 45% of causes of death [15]. Overall, the three primary health risk factors are dietary, high blood pressure, and high Body-Mass Index (BMI).

Obesity represents a major public health concern; with a prevalence of about 34% for women and 20.9% for men (higher than surrounding countries) [17]. Tobacco consumption is responsible for approximately 22% of all cancer deaths. Estimated tobacco smoking among university students (18–26 years) was 24.73% for cigarettes (39.82% male, 5.54% female) and 30.4% for water pipe (33.2% male, 26.8% female) [18]. The Aleppo Household Survey involved a representative sample of 2038 adults. The prevalence of cigarette smoking was 56.9% among men and 17.0% among women, while the prevalence of waterpipe smoking was 20.2% among men and 4.8% in women [19].

Syria's Presidential Decree no. 62, in 2009 banned smoking including the waterpipe inside cafes, restaurants, and other public spaces. This law went into effect in April 2010 [29]. Syria was the first Arab country to introduce such a ban. The decree also outlaws smoking in educational institutions, health centres, sports halls, cinemas, theatres, and on public transport. A previous decree in 1996 banned tobacco advertising. People under the age of 18 are not allowed to buy tobacco in Syria.

Other risk factors include alcohol consumption, viral infections (especially HBV, HCV, HPV, and EBV), exposure to ultraviolet light or ionizing radiation, and increased exposure to industrial and agricultural carcinogens. Furthermore, post-war environmental pollution is an added risk factor for cancer in Syria [16].

According to the global review of hepatitis B and C in 2013, the Syrian Arab Republic is classified as having a high prevalence of hepatitis C virus (HCV) and low–intermediate prevalence of hepatitis B virus (HBV). The decreasing trend in HBV positivity may be linked to the continuous HBV vaccination programmes. The highest positivity for HBV and HCV was seen in the northern and eastern regions according to a 2004 survey by the Syrian MoH in cooperation with the Central Bureau of Statistics. The seroprevalence of HCV was found to be 2.8% as indicated by HCV antibodies and 5.6% for HBV as indicated by HBV surface antigen (HBsAg) [22]. HPV-related cancer incidence in Syria (estimates for 2012) is 2.8, 0.5, 0.1 per 100,000 for cervix uteri, other anogenital, and head and neck cancer, respectively [23].

17.6 Cancer Screening Programmes

The cancer screening and prevention programmes initiated in Syria under MOH coverage along with partners, namely the Ministry of Social Affairs and Labour (MOSAL), civil societies, and the WHO. Many of these programmes were established following 2018–2019. These programmes play an important role in raising awareness through educating the general population about cancer prevention, screening, counselling programmes, and epidemiology studies. Recently, the Syrian government has developed several national cancer awareness and screening programmes, particularly focusing on breast cancer, cervical cancer, prostate cancer, and colon cancer.

The Syrian Society of Breast Cancer, established in 2006, by the MOSAL, played an important role in breast cancer early detection campaign collaborating with civil societies like the Syrian Family Planning Society, Red Crescent, and others, offering counselling, educational programmes, breast ultrasound and mammogram to all women aged 35–70. The first major national early detection and screening programme was done in October 2019, guided by the Syrian National Committee for cancer control. This screened a total of 380,000 women aged 35–70 by mammogram and with guided biopsy for those with suspected lesions. Several national screening programmes were interrupted by the conflict in the country and by the COVID-19 pandemic.

17.7 Cancer Prevention Programmes

Human Papillomavirus (HPV) vaccine was supported by the government but not routinely used before the crisis. Cervical cancer ranks as the 12th most frequent cancer among women in Syria and ninth most frequent cancer among women between 15 and 44 years of age. Around 2.5% of women in the general population are estimated to carry cervical HPV 16/18 infection at a given time, and 72.4% of invasive cervical cancers are attributed to HPVs 16 or 18 [26]. The fact that cervical cancer is preventable necessitates the 2021 national campaign programme by the NCCC and MOH with WHO partnership for cervical cancer screening.

The MOH in partnership with the WHO conducts a programme with the aim of eliminating new hepatitis B and C infections in Syria by 2030 and reduction of chronic hepatitis cases and hence hepatocellular carcinoma (HCC) liver cancer.

In addition to breast cancer screening and prevention programmes, the Tobacco Control Law (174/2011) was also introduced in August 2011 for tobacco control and regulation of tobacco products' manufacturing, packaging, and advertising that forbid smoking indoors, at workplace and in public transportation [18].

17.8 Cancer Diagnosis

17.8.1 *Imaging*

Radiation therapy was established in Syria at the Nuclear Medicine Centre (the oldest radiotherapy centre in Syria) in the 1970s. Since then, the role of diagnostic radiology has rapidly expanded in both the public and private sectors. Many challenges facing this field in terms of equipment, devices, and expertise have arisen during the crisis. Sanctions and financial difficulties prevented new devices from replacing damaged ones. Current active nuclear medicine centres are mostly located in big cities like Damascus, Aleppo, Latakia, Swayda, and Tartouse. The radiation doses delivered to patients are monitored with accurate radiation dosimeters to save patients from radiation injuries. These dosimeters are calibrated at the Secondary Standards Dosimetry Laboratory (SSDL). In addition, a dedicated Quality Audit programme (QA) of the radiation doses delivered to patients in the radiotherapy centres around the country has been established. A recent survey showed that active imaging includes about 351 Computed Tomography (CT) scans, 170 Magnetic Resonance Imaging (MRI) machines, 4 Positron Emission Tomography (PET-CT) devices (located in Damascus), 7 Gamma cameras (including Single Photon Emission Computed Tomography (SPECT) System), and one clinical cyclotron. Few other facilities include 1100 general X-ray systems, 314 fluoroscopy and angiography systems, 185 mammography machines, 769 panoramic and cephalometric X-ray equipment, 69 bone-densitometry systems, 74 interventional radiology systems for cardiology, neuroradiology, and peripheral vascular. According to the Syrian Radiologist Society, there are more than 400 radiologists in Syria.

According to the Atomic Energy Commission of Syria (AECS), a list of available diagnostic tracers is ^{131}I , $^{99\text{m}}\text{Tc}$, ^{67}Ga citrate, $^{123}\text{I-NaI}$, $^{123}\text{I-Datscan}$, $^{201}\text{TlCl}$, $^{123}\text{I-MIBG}$, $^{18\text{F-FDG}}$, $^{18\text{F-NaF}}$, ^{11}C -radiotracers and therapeutic agents (^{186}Re , ^{64}Cu , $^{64}\text{Cu-DOTATATE}$, ^{90}Y , ^{89}Sr) [20]. Based on the latest data from MOH (AECS), there are about 8 nuclear medicine physicians, in addition to 25 medical physicists available in the country.

17.8.2 *Laboratory*

Histopathology plays an essential role in oncology, both in the initial tissue diagnosis of the tumour and later in the detailed examination of the surgical specimen. Immunohistochemistry has revolutionized histopathology over the last 20–30 years and a number of tumours now require immunohistochemistry for their accurate diagnosis or sub-classification. Molecular genetic analysis has significantly changed the physician's treatment decisions to more precise personalized management. Pathology in Syria is expanding and integrating these advanced techniques into daily practice for patients' benefit. The main public diagnostic cancer lab is at the Al Bairouni University Hospital and Atomic Energy Commission of Syria.

17.8.3 Cytogenetics and Molecular Genetics

Cytogenetic (karyotype, cytogenetic for both constitutional and non-constitutional defects) and molecular genetic techniques are available in Syria. These are provided by both the government and private sectors. University hospitals and Atomic Energy Commission of Syria are the main providers and perform tests of high standards by highly trained and dedicated staff. These advanced tests include a wide range of molecular techniques from conventional Fluorescence in Situ Hybridization (FISH) and Polymerase Chain Reaction (PCR, e.g. Reverse Transcription (RT-PCR) and quantitative (qPCR)) for diagnosis and monitoring residual disease activity for haematological and non-haematological cancers. Mutation driven studies aimed at adopting certain targeted therapy including EGFR, KRAS, and BRAF are routinely done. Liquid biopsy/Next Generation Sequencing (NGS) is funded by the government for research purposes.

17.9 Treatment

17.9.1 Medical Oncology

17.9.1.1 Advanced Treatments

All essentials cancer care outlined by the WHO cancer care in addition to advanced services such as mutation guided and targeted therapy (i.e. first to third generation of anti-Her2, anti-CD20 for Lymphoma, TKIs for CML or CLL for HCC, RCC, mutations guided treatment in lung, colon, etc.) are provided by the Syrian MOH. The oncology committee in each institution sets the indicators and guidelines for each disease. The Syrian National Cancer committee with the Syrian Association of Oncology and Scientific boards is processing a national guideline based on overall survival rate, progression free survival, national burden of disease, and financial considerations. This aims to parallel global guidelines such as those by the WHO, NICE, European Society for Medical Oncology, National Comprehensive Cancer Network.

17.9.1.2 Bone Marrow Transplantation

Syria first started bone marrow transplantation (BMT) in 2008, at Tishreen Military Hospital, Ministry of Defence (MOD), Damascus. This was followed by the Syrian Stem Cell Transplant Group (SSCTG) in 2012, Damascus. These offer both autologous and allogeneic transplant types. To date, approximately 150 cases have been transplanted. Among them, 85% of the cases are autologous transplant and 15% are allogeneic. Transplants slowed down during the crisis for many reasons [27].

A standard of care paediatric transplant centre is currently being established at the Children University Hospital. This centre is fully supported by the government and will run a free service for all Syrian children.

17.9.2 Radiation Therapy

Radiation oncology is mostly provided by the Ministry of Higher Education (MOHE). All governmental radiation services within MOHE and MOH are free of charge. Private radiotherapy services are limited. Radiation oncology is located mainly in two cities, Damascus and Latakia with tremendous efforts to renovate Aleppo and Homs post-war. There are five modern active linear accelerators delivering standard safe External Beam Radiotherapy (EBRT) treatment that includes traditional 2D/3D conformal radiation therapy, Intensity Modulated Radiation Therapy (IMRT), Image Guided Radiotherapy (IGRT), and brachytherapy system. Also, there are five cobalt-60 machines that support these services. About 30 devoted radiation oncologists collaborate with highly qualified technicians and physicists to provide successful advanced radiation treatment options to the patients. Close cooperation between the AECS and University of Damascus exists to provide education and training related to nuclear science and technology including radiation protection and medical physics. The Nuclear Science and Technology Training Centre (NSTTC), opened in February 2010, has one of the most important strategic solutions to meet the country's needs.

Currently, it is a big task to fulfil treatment requirements in time for all patients, with one linear accelerator per three million, a delay in appointments is expected. A rapid assessment survey conducted by the WHO in 2016 showed a 30-day waiting period for radiotherapy treatment (Fig. 17.5). Sanctions imposed on Syria prevent the maintenance and repair of the damaged parts of the machines which contributes to these delays [11].

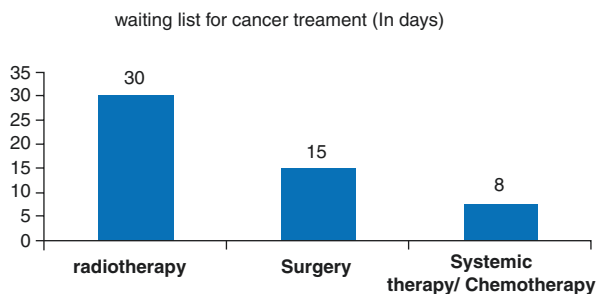


Fig. 17.5 Waiting list for each cancer treatment type (systemic therapy/chemotherapy, surgery, and radiotherapy) [11]. Used with permission from Maha Manachi

The National Cancer Committee Plan in collaboration with AECS aims to provide more advanced linear accelerators from the year 2021. These particularly aim to target the north, middle, and east of Syria to deliver the necessary cancer treatment to all patients. Nonetheless, radiation oncology is associated with significant costs especially with regard to the purchase and maintenance of expensive complex machinery required as well as the required international licensing.

17.9.3 Surgery

With the recognition of surgical oncology as a separate speciality, the training programmes in this field were first accredited by the MOH about 15 years ago. Nearly 25 surgical oncologists have registered in Syria. Limb sparing and breast saving surgery are the most commonly performed surgeries up to date [30].

17.9.4 Paediatric Oncology

Paediatric cancers account for 10% of the total number of cases. The estimated annual new paediatric cancer cases are about 1200. Most five common cancers according to 2019 data are Central Nervous System (CNS), leukaemia, lymphoma, bone and soft tissue sarcoma, and kidney followed by eye cancers.

A few paediatric oncology centres in Syria deliver cancer care as a part of paediatric general hospitals. The national referral centre is in Damascus at Children University Hospital which handles most cases up to age 13. All radiotherapy cases are referred to the Al Bairouni University Hospital.

Most facilities are available at Children University Hospital, i.e. diagnostic labs, Computed Tomography (CT) scans, Magnetic Resonance Imaging (MRI), pathology lab, and flow cytometry as well as specialized adequate blood bank with full blood component support. Treatment guidelines are according to the International Society of Paediatric Oncology (SIOP), St Jude, and other global guidelines for paediatric cancer. A paediatric bone marrow transplant unit is going to be established in 2021.

Other governmental paediatric centres are at Al Bairouni University Hospital (ABUH), Tishreen Military Hospital in Damascus, Tishreen University Hospital in Latakia, Aleppo National Hospital, and Al Kendi University Hospital [31].

BASMA society is a non-governmental organization (NGO) in Syria that supports children with cancer including the provision of all treatment types free of charge. About 200 new annual cases were added to the BASMA registry in 2019 (Fig. 17.6).

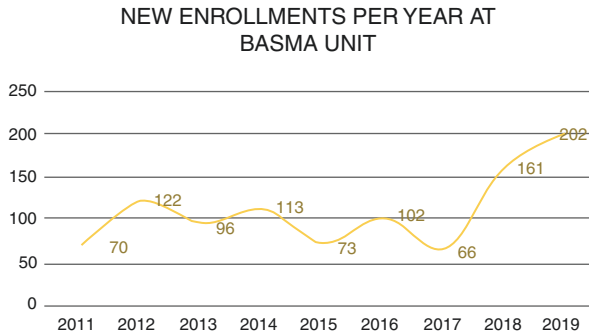


Fig. 17.6 Number of paediatric new cancer cases registered at BASMA per year (Ghanem et al., manuscript in press) [32]. Used with permission from Khaled Ghanem (BASMA)

17.9.5 Survivorship Track

The clinical outcome of patients enrolled between 2009 and 2018 was difficult to measure due to a high percentage (18%) of lost follow-up cases because of war. We are sure that at least 50% of patients diagnosed between 2009 and 2018 survived the disease. Between June 2018 and May 2020, the short-term 2-year overall survival rate of the 363 enrolled patients exceeded 90% with a very low treatment-related mortality rate of 2%. Multiple research and quality improvement projects are currently ongoing in the unit, including data management and infection control programmes. The unit has very good ties with regional and international tertiary care paediatric oncology hospitals [31].

17.9.6 Palliative Care Track

The need for Palliative Care (PC) is increasing due to the ageing population and increased incidence of cancer and other NCDs. About 30% of NCDs are cancers with end-of-life complications and pain [21]. Despite this need, palliative care is underdeveloped and limited in Syria and has worsened after the crisis. The MoH acknowledges Palliative Care (PC) as a part of the healthcare system and defines the national clinical guidelines and protocols that aim to enhance patients' quality of life and improve patient outcomes. MOH provides legal medical access to opioids when available and mostly in injection forms. Other slow-release oral morphine types are not available at the current time.

The WHO rapid assessment data in 2016 showed that 88% of inpatient settings had palliative care, while the mentioned service was available in 75% of outpatients and in 63% of community or home based [9]. The highest primary barriers to palliative care services were inadequate financial resources and limited human resources expertise (88%), while low health priority accounts for (50%) among primary barriers and the lowest barriers were related to lack of referral mechanisms [11].

17.10 Research and Education

The School of Medicine was founded in Damascus in 1901 but officially opened in 1903 and consisted of the faculties of Medicine and Pharmacy. The University of Damascus is the largest and oldest university in Syria, founded in 1923 through the merger of the School of Medicine and the Institute of Law. In Syria, 7 out of 8 public universities teach medicine, whereas 3 out of 23 private universities do. Medicine is primarily taught in Arabic [28]. During the recent decades, a significant amount of research has been conducted in Syria, particularly the University of Damascus. Annually, over hundreds of research papers have been published in Syria. However, a smaller number of papers are published in peer review journals. The collaboration between Faculty of Medicine, Oncology Division at ABUH, and the Faculty of Pharmacy is well established with the main focus being at the molecular level in cancer cell biology. Moreover, there is a profound research collaboration between the AECS and ABUH. The cross-region universities have a curriculum in accordance with the University of Saint Joseph (USJ) in Beirut, which has been considered a good example of fruitful collaboration.

17.11 Challenges and Advantages

17.11.1 *Oncology Physicians*

The Syrian Association of Oncology (SAO) was established in 1997 and has been a part of the Syrian Medical Association since then [32]. About 150 active consultants are registered as oncologist, haematologist, and radiotherapist. Most of them received their speciality training in Syria, 60–70% of consultants have experience or higher degrees from abroad such as Russia, UK, France, Spain, and the USA. All are registered under the Syrian MOH with accreditation from the Syrian Board in haematology, oncology, radiation oncology as well as paediatric oncology [33].

The SAO has a good scientific relationship and collaborates extensively with similar societies in the Middle East and North-Africa and Gulf regions. As such, the SAO has played an important role in the establishment of the Arab Medical Association Against Cancer (AMAAC).

17.12 The Future of Cancer Care in Syria

Cancer care in Syria is progressing rapidly, hence a new era has begun in cancer management with different modalities that give better treatment options to patients. These include the advancement of molecular pathology techniques with the ability to detect targetable mutations and immunotherapies. The responsibilities are extremely high on medical bodies to raise and maintain different oncology domains up to standards. There

are major difficulties that both the government and medical professionals have experienced especially with over a decade of war, destruction of healthcare facilities, harsh economic sanctions, people displacements, and loss of human resources.

The National Cancer Control Committee, MoH, and MoHE, in collaboration with allied medical bodies both governmental and non-governmental, are working on five objectives (outlined below). In addition, they also constantly reinforce strategic regional partnerships, with the aim for fruitful and effective communication with other countries and centres which support the country's national plan and aid in improving the country's institutions, as well as adopting clear standards and systematic policies.

- Reducing cancer incidence rates through primary prevention.
- Ensuring the implementation of effective early screening and detection programmes in order to reduce mortality rates especially for breast, cervical, colon, and prostate cancers. This also includes increasing population awareness and participation in these programmes.
- Ensuring effective diagnosis and treatment to reduce cancer morbidity and mortality rates. This also involves the development of national treatment protocols in accordance with international standards for cancer management but specifically tailored to Syria's demographics, needs, and capabilities.
- Improving the quality of life for cancer patients via rehabilitation and palliative care.
- Improving cancer research.

17.13 Conclusion

Since 1969, oncology, both in Syria and internationally, has been advancing rapidly as reflected in significantly improved survival rates. These improvements in Syria's oncology care were largely attributable to government efforts in providing advanced centres equipped with the necessary resources to handle the rising incidence of cancer such as Al Bairouni University Hospital. Medical societies, the private sector, and civil societies also played an important role. Unfortunately, as with most other aspects of Syrian healthcare, the progress in cancer care was radically interrupted by over a decade of crisis involving a violent conflict and harsh economic sanctions. These destroyed previously developed resources and institutions, limited the import of new equipment and technologies, and led to the loss of human resources. Despite all of this, healthcare professionals continue to work tirelessly, overcoming unimaginable obstacles and often working under extremely difficult conditions to provide the best care they can for their patients. For this we would like to recognize Syrian doctors, particularly our fellow oncologists, and all other allied healthcare workers as the unsung heroes they truly are. Nonetheless, recent improvements including a significant decrease in the violence make us hopeful of a new era in Syrian healthcare but especially oncology. We particularly aim to keep up, implement, and contribute to the immense improvements and research in cancer care globally. For this purpose, a

multitude of medical bodies collaborate but importantly the National Committee for Cancer Control is responsible for coordinating these efforts. The National Cancer Registry has been re-established and progressing to give a solid cancer registry data that is crucial to develop a national strategy with clear research objectives and comprehensive centres. Currently, our focus is on establishing unified guidelines, providing up-to-date national essential cancer medical list, restoring and building additional comprehensive cancer centres with the capacity for advanced management options such as radiation oncology systems, and expanding the role of palliative care.

Conflict of Interest Authors have no conflict of interest to declare.

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Abbreviations

ABUH	Al Bairouni University Hospital
AECS	Atomic Energy Commission of Syria
EBRT	External beam radiotherapy
EML	Essentials medicine list
IAEA	International Atomic Agency Association
IARC	International Agency for Research on Cancer
IGRT	Image-guided radiotherapy
IMRT	Intensity-guided radiotherapy
LINAC	Linear accelerator
LMICs	Low- and middle-income countries
MENA	Middle East and North Africa
MOD	Ministry of Defence
MOH	Ministry of Health
MOHE	Ministry of Higher Education
MOLA	Ministry of Local Administration
MOSAL	Ministry of Social Affairs and Labour
NCCP	National Cancer Control Plan
NGO	Non-Governmental Organization
PPP	Public-private partnership
SHI	Social Health Insurance

SNCCC	Syrian National Committee for Cancer Control
SNCR	Syrian National Cancer Registry
SPECT	Single photon emission computed tomography
SRS	Syrian Radiological Society
WHO	World Health Organization

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