Impact of the Syrian conflict and forced displacement on respiratory health: an analysis of primary data from a humanitarian organisation

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ABSTRACT

Background Despite a decade of conflict, there has been little exploration of respiratory health in Syria, notwithstanding the known impacts of conflict on lung health. Our aim is to explore the burden and trends of respiratory consultations in Syrian American Medical Society (SAMS) facilities in northwest Syria through an ecological analysis.

Methods We performed a retrospective review of routinely collected data relating to respiratory presentations in SAMS' facilities between March 2017 and June 2020; we compared data by facility type, infectious versus non-infectious aetiologies and age.

Results Data were available for 5058864 consultations, of which 1,228,722 (24%) were respiratory presentations, across 22 hospitals, 22 primary healthcare centres, 3 mobile clinics and 1 polyclinic. The median number of respiratory consultations per month was 30,279 (IQR: 25,792–33,732). Key findings include: 73% of respiratory consultations were for children; respiratory presentations accounted for up to 38% of consultations each month, seasonal variation was evident; respiratory tract infections accounted for 91% of all respiratory presentations. A steep decrease in consultations occurred between the end of 2019 (160,000) and the first quarter of 2020 (90,000), correlating with an escalation of violence in Idlib governorate.

Conclusion This study presents the largest quantitative analysis of respiratory data collected during the Syrian conflict. It supports the need for improved measures to aid the prevention, diagnosis and management of respiratory conditions during conflict as well as further research to explore the impact of conflict on respiratory health.

INTRODUCTION

Respiratory tract diseases account for a high burden of morbidity and mortality internationally. The Global Burden of Disease estimates that chronic respiratory disease ranked third and respiratory tract infections (RTIs) and tuberculosis (TB) together ranked fourth for causes of death globally in 2019.1 Conflict exacerbates existing respiratory conditions and contributes to underdiagnosis through its effect on the health system; it also affects the management of existing respiratory conditions due to its adverse effects on the availability of required medications and the insufficient number of trained healthcare staff.2 Additionally, during conflict, social determinants play an increasingly important role; for example, the destruction of shelter, exposure to the elements and increased smoking prevalence can also contribute to poor respiratory health.

Syria, a country which descended into conflict after peaceful uprisings against the government began in March 2011, has now faced a protracted conflict which has resulted in the death of an estimated 610,000 people,3
destroyed and fragmented its health system and left 14.6 million people in need of humanitarian assistance within the country by the end of 2022.4 There have been ongoing, often deliberate attacks on healthcare by the government of Syria and its allies in regions under non-government control, further weakening the health system in these areas and forcing the exodus of healthcare workers; this has left few respiratory specialists remaining.2

Lung health is negatively affected by the high smoking rates in Syria, which has increased with the conflict2,5 as well as other environmental impacts including the inhalation of building materials or rubble after bombing (contributing to respiratory failure) particularly from barrel bombs which may also be contaminated with chemicals or other substances. Those who are internally displaced in Syria (6.8 million as of May 2023) are particularly vulnerable to respiratory problems due to inadequate shelter and exposure to the elements. The overcrowded living conditions can also increase the spread of infectious diseases including RTIs, TB and other respiratory viruses including SARS-CoV-2.6

The permissive use of chemical weapons in the Syrian conflict has been widely documented. Examples of gases used include sarin, chlorine and sulfur mustard gas.27 All of these gases damage the respiratory system, with the effects of sarin and chlorine gases taking up to 10 minutes and between a few minutes and half an hour, depending on concentration, to kill, respectively.66 There have been at least 126 documented attacks with chemical agents in parts of Aleppo and Idlib governorates of northwest Syria, where the study’s population resides.10 The health effects of mustard gas on the other hand can take decades to develop, presenting in various forms including: bronchiolitis obliterans, pulmonary fibrosis, chronic obstructive pulmonary disease (COPD) and asthma.11 The effects of these gases and the effects of rubble from blasts need to be considered when looking at the respiratory health of the population.

Despite the known impacts of conflict on respiratory health, there has been little analysis of primary data particularly of large scale, which aims to understand the impact of conflict on respiratory presentations. The aim of this research is to understand the impact of the conflict on the trends of respiratory diseases and proportional morbidity in Syrian American Medical Society’s (SAMS) facilities in northwest Syria.

METHODS
This retrospective review analyses the data on respiratory presentations collected from SAMS-operated facilities in northwest Syria. SAMS is a humanitarian non-governmental organisation dedicated to delivering essential medical aid to those affected by the crisis in Syria and neighbouring countries. The data span from 2017 to June 2020. The data were routinely collected in the different primary and secondary healthcare facilities and reported back to the Gaziantep, Turkey based regional office of SAMS. This is done on a weekly basis and is inputted into SAMS’ computerised health information system (HIS) which includes ICD-10 (International Classification of Diseases 10th Revision) coding.

Setting
During the conflict, SAMS operated in various parts of Syria, including Deraa, eastern Ghouta, eastern Aleppo, Hom, Idlib, Raqqa and Hama. For the period of this study, its main areas of operation were in northwest Syria, which includes parts of the western Idlib and northern Aleppo governorates as of December 2020. This area has seen extensive shelling including the use of barrel bombs and chemical weapons over the course of the conflict. This area shelters 4.17 million people, of which 2.7 million are internally displaced people (IDP) and 1.4 million reside in camps.12 SAMS currently operates in certain parts of northeast Syria as well.

Data
All data from SAMS’ regional office which were relevant to respiratory health were downloaded from the HIS in an anonymised format with no patient-identifiable data. The data were shared with one of the members of the research team who performed the analyses. The data were provided in an aggregated format by month for each facility.

Data collection
Data entrants based in SAMS’ health facilities extract data from notes and input it into the DHIS-2 (District Health Information Software 2) system on a weekly basis; this is with prestructured fields and in line with ICD-10 classification.

Data variables
The variables collected included counts of patient consultations broken down by age (over and under 18 years) and general disease categories, subdivided into infectious and non-infectious, by facility. These are included as a table in online supplemental appendix A. Overarching categories were ‘chronic respiratory disease’, ‘respiratory tract infection’, ‘asthma’, and ‘inhalation of chemicals, gases, fumes, and vapours’.

Bias
Data provided were collected for routine clinical purposes for operational reporting and donor reports; it was provided from SAMS facilities which account for around 15% of all facilities in northwest Syria during that period.
Analyses
The scope of the data analysis was dictated by data availability and the locations of SAMS facilities. All available data were obtained so size calculations were not made. Data were analysed using R statistical programming. Relevant summary data frames were generated using the dplyr package from which trends in respiratory consultations over time, trends by age and type of respiratory consultation, and by type of facility were produced using a combination of base R graphical features and the ggplot2 package. Analysis was restricted to basic summary and descriptive statistics, with no statistical techniques employed to quantify the various relationships observed. As such, exploratory analysis was limited to a visual and contextual consideration of the graphics that were generated and so should not be interpreted as statistically robust inferences.

RESULTS
The dataset under analysis was from March 2017 to June 2020 and consisted of routinely collected clinical data from 48 SAMS facilities: 22 hospitals, 22 primary healthcare centres (PHCs), 3 mobile clinics and 1 polyclinic (listed as ‘other’ in the figures below). Thirteen facilities had data available for the entire time frame (five hospitals, six PHCs and two mobile clinics; see figure 1A,B).

We report on 1,228,722 consultations with respiratory presentations out of a total number of 5,058,864 consultations during this period (24.3%). Of these, 332,398 consultations (27.05%) were seen in adults and 896,324 among children (72.95%). A total of 547,307 respiratory consultations (44.54%) were seen in hospitals, 545,255 (44.38%) in PHCs and 115,408 (9.39%) in mobile clinics. The median number of respiratory consultations per month was 30,279 (25,792–33,732) out of a median 128,923 total consultations (112,917–140,189).

Types of respiratory presentation were split broadly into infectious, non-infectious and other, categorised according to online supplemental appendix A.

Trends in respiratory consultations
Figure 1C,D show the trends in total monthly consultations by type of facility and overall. There is an increase
in overall consultations from just under 100,000 consultations per month in early 2017, to almost 160,000 by the last quarter of 2019. After this, there is a sharp drop in consultations to 90,000 consultations by the second quarter of 2020, before starting to rise again.

Figure 2A shows a clear pattern of seasonal peaks in the winter months (December–February) and troughs in the summer months (June–August). When comparing trends by quarter, there are similarities in the seasonal peaks and troughs. The burden of respiratory disease ranges between 17% and 38%. Figure 2B shows a significantly higher number of respiratory consultations in children as compared with adults. At the end of 2018, there was a large spike in paediatric consultations, with a smaller spike in adult consultations.

Trends by infectious and non-infectious respiratory presentations

Infectious diseases were the most common presentation among all ages (figure 2C), with fewer non-infectious and ‘other’ consultations. Hospitals and PHCs contributed to the infectious peak in 2018 (figure 2D), with hospitals having higher numbers. The non-infectious peak in 2018 was attributed to a single hospital (figure 3A), with over 1000 consultations in a month. Non-infectious and ‘other’ consultations were lower in both age groups, with a small 2018 peak in children (figure 2D).

COVID-19 cases were not included in the infectious category as the first case in northwest Syria was confirmed on 9 July 2020,13 beyond the data range and a few months after WHO declared the pandemic.

Chronic respiratory conditions

A median of 1160 (1032–1347) asthma consultations were recorded monthly, peaking at the end of 2018 (n=2422) (figure 3B). Figure 3C shows asthma consultations for adults (~390–1150 monthly) and children (~250–1270 monthly). Adults had higher consultations throughout the study, except during the end-of-2018 spike where children had the highest number. Hospitals and PHCs had the most asthma consultations. Both adult and child hospital consultations contributed to the 2018 peak, while only child consultations peaked at PHCs. Adults had higher consultations in all facilities except hospitals (figure 3D). Mobile clinics had the largest difference between adult and paediatric asthma consultations.
consultations (~120 vs ~30 monthly), with consultations slowly decreasing over the study period.

**Trends of presentation of inhalation of chemicals, gases, fumes and vapours**

A total of 321 consultations were reported over the period. Figure 4A presents the consultations per month of inhalation of chemicals, gases, fumes and vapours. There are two clear peaks in consultations, the first being in April 2017 (n=19) and the second in November 2019 (n=36), with a steady increase in consultations throughout 2019.

**Trends by type of facility**

Figure 1C shows the total consultations by facility type. Hospitals reported the highest number of total consultations at 2775828 (55%), followed by PHCs at 1853289 (37%). Mobile clinics reported far less consultations overall (324756, 6%) as the study only included three clinics (see figure 1C). However, the greatest number of facilities providing data throughout the entire study period were PHCs, followed by hospitals, then mobile clinics (see figure 1B). There was a drop in the number of hospitals providing data in March 2018 and a drop in the number of both PHCs and hospitals at the start of 2020. Data from ‘other’ facilities are only provided up to the last quarter of 2018 (figure 1B). Respiratory presentations accounted for the lowest proportion of total consultations in hospitals (12–34%) compared with PHCs (20–45%) and mobile clinics (20–50%), as seen in figure 4B. The seasonal trend of respiratory disease is consistent among all types of facilities (figure 4B).

The three mobile clinics saw the smallest number of all respiratory presentations compared with the other facilities (see figure 4C). PHCs and hospitals reported similar numbers of consultations for all respiratory diseases for most of the study period. However, there is a notable increase in non-infectious and ‘other’ presentations in hospitals at the start of 2019 and end of 2019, respectively (see figure 4B).

There was a downward trend in the number of facilities providing data over the years, but two steep drops are shown: in the first half of 2018 and through the start of 2020 (see figure 4D).

Figure 4C shows the respiratory consultations per month in each type of facility by age. There was a larger
number of paediatric consultations in all types of facilities. There is a peak in consultations for both age groups at the end of 2018 in all facility types, although the peak is much greater in children. There is a large peak in consultations at the end of 2017 in mobile facilities for both age groups. Table 1 provides a summary of the key findings.

DISCUSSION
This quantitative analysis of SAMS data between March 2017 and June 2020 included data from 5,058,864 consultations (median of 128,923 per month) and showed a large burden of respiratory disease accounting for 17–38% of consultations. There was a clear seasonal trend in the respiratory disease burden throughout the study with peaks in winter. There was a drop in consultations at the end of 2019 and start of 2020 which is likely associated with the increased attacks on Idlib governorate between December 2019 and February 2020 by the Syrian government and its allies.14 This resulted in a massive population movement with almost 1 million moving from this area to safer areas in the north.15 RTIs were the most common presentation among both adults and children in the study.

The seasonal variation in respiratory burden found in our study can be seen globally and is attributed to the colder and damper environment and increased virus transmissibility during the winter season.16 Terkawi et al found a similar pattern in their study, with rates of upper respiratory tract infections increasing in winter months.17 In Syria, additional factors include: inadequate shelter, particularly during winter; overcrowding; higher smoking rates; and poor nutrition leading to increased susceptibility, particularly for IDPs.2 7 11 18–21 Planning services to accommodate for the higher respiratory burden in winter months will allow humanitarian organisations to provide relevant support without becoming overwhelmed and allow for improved budgeting of medical supplies.

The highest peak recorded for all respiratory diseases was in the winter of 2018. This could reflect a harsher winter that year, possibly supported by the higher number of infectious presentations in children during that winter. Harsher winters are associated with a change in immune function which can increase susceptibility and the population may spend more time indoors. Alternatively, it could be explained by a more stable period for the area allowing patients to attend healthcare facilities.

Figure 4 (A) The total number of cases per month related to inhalation of chemicals, gases, fumes and vapours. (B) Respiratory cases as a percentage of the total monthly consultations in each type of facility. (C) The total number of respiratory cases in children and adults per month in each facility type. (D) Scale adjusted: the number of facilities that provided data for the study each month. PHC, primary healthcare centre.
Respiratory disease burden accounted for 17–38% of all cases. The peak of non-infectious consultations at the end of 2018 was caused by a spike in consultations from a single hospital. There was a higher number of asthma presentations in adults than in children. Most asthma consultations were recorded in hospitals and PHCs.

### Trends by type of facility
- Data were available from 22 hospitals, 22 PHCs and 3 mobile clinics. 7 hospitals and 6 PHCs reported data for the whole period.
- 547,307 presentations (44.54%) were seen in hospitals, 545,255 (44.38%) in PHCs and 115,408 (9.39%) in mobile clinics.
- Respiratory diseases accounted for the largest proportion of the disease burden in mobile clinics (30–50%) and the lowest in hospitals (5–33%).
- There was a drop in the total number of facilities providing information towards the end of 2018 when hostilities increased; this was from 28 to 22.
- There was a drop in the number of hospitals providing data in the second quarter of 2018 from 16 to 11; however, this was not the case for PHCs.

### Trends by infectious and non-infectious respiratory presentations
- Infectious presentations were the most common respiratory category in all facilities among all age groups.
- The peak of non-infectious consultations at the end of 2018 was caused by a spike in consultations in a single hospital.
- There was a median of 1,160 (IQR: 1032–1347) asthma consultations per month.
- There was a higher number of asthma presentations in adults than in children.
- Most asthma consultations were recorded in hospitals and PHCs.

### Trends of presentations of inhalation of chemicals, gases, fumes and vapours
- A total of 321 consultations were recorded.
- There were two peaks in consultations, the first being in April 2017 (19 patients) and the second in November 2019 (36 patients).

**PHCs, primary healthcare centres; SAMS, Syrian American Medical Society.**

for conditions they could see as more trivial. However, it is most likely due to an increase in consultations from a single facility augmenting the results, supported by the spike in non-infectious consultations originating from a single hospital (see figure 3A).

Those under 18 years old accounted for the largest proportion of respiratory presentations overall (73%). However, it is not possible to ascertain if this is significant as due to local population movements related to conflict, it is not possible to ascertain the percentage of those under 18 years old in the population as a whole. It is however recognised that children are particularly vulnerable in conflict situations,22 have higher rates of asthma23 and are more prone to RTIs.24

### RTIs as an important cause of morbidity
The largest disease burden on health globally is attributed to respiratory infections.25 This is mirrored in this study where the largest proportion of respiratory presentations was due to infectious diseases (1,115,888 of 1,228,722; 90.82%). This is not unexpected due to the significant global burden of RTIs26 and the living conditions faced by the population in northwest Syria, including limited sanitation facilities, malnutrition and overcrowding,6 which likely exacerbate the spread of causative organisms. RTIs contribute 17–23% of deaths in children under 5 years old worldwide, whereas in conflict settings, this reaches 20–35%.27 It is notable that the number of consultations in our study is significantly higher in children than adults; this could be related to demographic factors or the generally higher proportion of RTIs which children experience.24 Regardless, the documented increase in morbidity and mortality of these diseases in conflict situations27 highlights the importance of finding solutions to combat the high rates of infection.

The most significant difference between adult and child consultations in the study was in infectious presentations where the average monthly consultations in children were ~25,000, whereas in adults, the average number of consultations was ~7,500. One study found that children under 5 years were found to have the highest mortality rates among refugees, with acute respiratory infections being among the most common cause of death.28
Presumed underdiagnosis of bronchial airway diseases

Asthma and COPD account for 3.9% and 0.08% of respiratory consultations, respectively (65.46% and 1.3% of non-infectious consultations), with a higher number of asthma consultations reported among adults. It is reported that the burden of asthma in the Middle Eastern region is 8%; therefore, asthma is likely underdiagnosed in this study. It is difficult to infer a cause for the higher rates of asthma diagnoses in adults as compared with children due to the lack of relevant demographic data in the study. It should be noted however that the higher number of consultations for asthma in adults is inconsistent with the higher overall respiratory presentations in children. There is a peak in child asthma presentations in PHC facilities at the end of 2018; this in fact relates to an increase in reported consultations from a single facility (Osama Al-Baroudi PHC in Idlib governorate) which skewed the overall trend. The spike in asthma presentations in hospitals at the end of 2018 was also isolated at a single facility, a major Idlib hospital.

There is a very small number of COPD consultations (~25–30) recorded per month in the study. This could be related to underdiagnosis of the condition, which is supported by the findings from Mohammad’s (2017) study, or misdiagnosis of COPD among adult smokers as asthma. There was a spike of COPD consultations in the same major Idlib hospital as caused the spike in asthma consultations. This was due to the availability of a respiratory specialist in the hospital at that time. This further solidifies the theory that COPD and asthma are generally underdiagnosed as after the specialist left the hospital, the number of COPD and asthma consultations reported dropped back to the general baseline.

One paper noted several exacerbating factors for asthma and COPD during the conflict such as asthma triggers related to conflict including overcrowding and the smell of dead bodies, poverty, mental health conditions especially post-traumatic stress disorder, increasing smoking rates, poor access to treatment and the effects of mustard gas. A study looking at patients 20 years after exposure to mustard gas in the Iraq war found that 43% had developed asthma and 36% had developed COPD. A large proportion of the participants were under 45 years old at the time of the study. A separate study found that the rates of new-onset asthma was 6.6% in soldiers deployed to Iraq compared with 4.3% in soldiers stationed in the USA. These diseases therefore need to be considered in any long-term health system planning for Syria.

Impact of violence and forced displacement

At the end of 2019 and the beginning of 2020, there was a precipitous drop in the number of facilities providing data; this was due to the closure of health facilities and escalation of violence. Between December 2019 and February 2020, a further assault by the Syrian government and its Russian allies forcibly displaced around 1 million people from southern Idlib governorate to areas further north. There was also an increase in attacks on health facilities, for example, Ariha Surgical Hospital, Idlib Central Hospital, Jisr Al-Şughour clinic (PHC) and Maarat Al-ヌ’man National Hospital, which resulted in full or partial closures. Physicians for Human Rights recorded 13 attacks on healthcare facilities in northwest Syria between September 2019 and March 2020. Five of the included SAMS facilities could not provide data by the start of 2020 resulting in a loss of consultations from those facilities. However, rather than a corresponding increase in consultations recorded from other facilities in the study, there was an overall decrease to 90,000 in the second quarter of 2020 (figure 1D); this may suggest that people had moved away from the area. Closure of facilities and subsequent reduction in healthcare capacity were reported by Meiqari et al in Syria and in other conflict settings where health facilities are targeted including in Yemen.

Respiratory impacts of the inhalation of chemicals, gases, fumes and vapours

A smaller number of consultations (n=321 of 1,228,722; 0.026%) with presentations labelled as inhalation of chemicals, gases, fumes and vapours were reported; there was little other information about these. The first peak of consultations from the study occurred in April 2017 (19 of the total reported consultations). Though causality cannot be proven, it is notable that the Khan Sheikhoun chemical attack occurred on 4 April 2017 when Syrian government forces dropped a bomb containing sarin gas on the town which is in Idlib governorate in northwest Syria, resulting in the death of at least 89 people and injuring more than 540. There were at least 222 cases of chemical weapon use in Syria between 23 December 2012 and 30 November 2020, 217 of which were carried out by the Syrian government. At least 1510 deaths (95% of whom were civilians) and at least 11,212 injured people have been attributed to these attacks. Sarin, chlorine and mustard gases have all been used, all of which affect the respiratory system.

The reason for the second peak of inhalation of chemicals, gases, fumes and vapours consultations near the end of 2019 (36 of the total reported consultations) is less clear but could be related to increased displacement leading to more people living in makeshift accommodation unsuitable for winter, burning unsafe fuels for warmth. This is supported by a report from Médecins Sans Frontières (MSF), which notes the suffocation of a family of five due to burning unsafe fuel inside for warmth in an IDP camp in northwest Syria in the winter of 2019. A steady increase in consultations over 2019 leading to the peak of consultations at the end of 2019 was noted from the data. This may relate to the offensive launched by the Syrian government on Idlib governorate between April and August 2019, which was then followed by a further escalation in December 2019. These offensives
contributed to waves of displacement in the region over the year before the displacement of almost 1 million by between December 2019 and February 2020. The displacements increased the number of people living in inadequate shelters and burning unsafe fossil fuels.34

**Strengths and limitations**

Despite strengths of this analysis, limitations include potential underdiagnosis or overdiagnosis given that these are routinely collected humanitarian data in an area of active conflict; as such, diagnostics and specialist healthcare personnel can be limited. The nature of the attacks on healthcare facilities may have discouraged patients from presenting, potentially leading to an underestimation of the total number of respiratory consultations. It has not been possible to determine prevalence or incidence in this analysis as these are data from a single humanitarian organisation and therefore do not represent the total number of consultations in the region. In addition, population data in the governors or catchments served are not available in the public domain to the required granularity and, even if available, would change over the course of the analysis due to armed conflict and related forced displacement, making finding an accurate denominator challenging. A strength is that due to the number of consultations, this is the largest dataset on respiratory presentations during the Syrian conflict, offering valuable insights into potential impacts at different conflict stages.

**CONCLUSION**

Respiratory presentations are among the most commonly seen consultations worldwide and is more so in conflict-affected settings. Our research highlights the need for improved diagnostics, training of healthcare workers and real-time data collection and analysis of respiratory presentations in areas affected by conflict such as northwest Syria. In northwest Syria, collaboration among organisations and prioritised funding for a surveillance system which captures respiratory consultations in more detail than our dataset are required; this exists for syndromic surveillance of communicable diseases (including respiratory ones). There is also a need for improved training for respiratory specialists, something which has been emphasised by the recent SARS-CoV-2 pandemic. Funding and commitment from key stakeholders in different health systems across Syria are essential for these initiatives.

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**Contributors** AAb, AS, MWA and MH conceptualised and designed the research strategy, and contributed to writing, data synthesis and editing. AS carried out data extraction and analysis. LB wrote the first draft and contributed to editing. AAb, AS, IH, MWA and LB supported interpretation of the extracted data. AAl, AT, MH, RL and MK contributed to revisions of the manuscript and data interpretation, and edited the manuscript extensively. All authors have reviewed and commented on the manuscript through its different stages. AAb is the guarantor for the research project.

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**Ethics approval** The data request was approved by SAMS’ research committee which consists of eight researchers from diverse backgrounds but who have expertise in Syria. Data obtained were collected for routine clinical purposes and were received anonymised and in an aggregated format. As such, a formal ethics review was not sought.

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**Data availability statement** Data are available upon reasonable request. The data that support the findings of this study are of a confidential nature and as such are available from the corresponding author upon reasonable request.

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