
HUMAN RIGHTS WATCH

# DEATH BY CHEMICALS

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## The Syrian Government's Widespread and Systematic Use of Chemical Weapons

# Summary

All available evidence strongly suggests that on April 4, 2017, a Syrian government warplane attacked Khan Sheikhoun, a town in the northwestern governorate of Idlib, with a nerve agent, killing at least 90 people, 30 of them children. The death toll likely makes this the deadliest chemical attack since an attack killed hundreds in Ghouta, near Damascus, in August 2013.

The Khan Sheikhoun attack sparked international outrage, but the attack on Khan Sheikhoun was not the only recent chemical attack by the Syrian government. Three developments since late 2016 show that the Syrian government's use of chemical weapons has become widespread and systematic:

- Government warplanes appear to have dropped bombs with nerve agents on at least four occasions since December 12, including in Khan Sheikhoun;
- The government's use of helicopter-dropped chlorine-filled munitions has become more systematic;
- Government or pro-government ground-forces have started using improvised ground-launched munitions containing chlorine.

In at least some of the attacks, the intention appears to have been to inflict severe suffering on the civilian population, which would amount to crimes against humanity.

After the chemical attacks in Ghouta, the United Nations Security Council demanded that the Syrian government destroy its chemical stockpiles, weapons, and production capacity. In response, Syria acceded to the Chemical Weapons Convention in September 2013. In June 2014, the Organisation for the Prohibition of Chemical Weapons (OPCW) announced that it had shipped Syria's declared chemical weapons out of the country for destruction, though it continued attempting to verify the accuracy and completeness of the Syrian declaration.

But in fact, the Syrian government had already been using helicopters to drop improvised munitions filled with chlorine at least since April of that year. While the Chemical Weapons Convention does not ban chlorine because it has many civilian uses, the convention bans its use as a weapon. Yet, between April 2014 and late 2016, Human Rights Watch

documented 16 Syrian government attacks with chlorine contained in improvised air-dropped munitions. The number of attacks reported in the media and on social media is much higher. A UN-OPCW Joint Investigative Mechanism found enough evidence in three attacks with chlorine in 2014 and 2015 to conclude that the government was responsible.

Human Rights Watch interviewed 60 people with first-hand knowledge of the chemical attacks and their immediate aftermath, and reviewed dozens of photos and videos of impact sites and victims that were posted online and provided directly by local residents, but was unable to conduct ground investigations of the attack sites.

Information from local residents in Khan Sheikhoun indicates that a warplane flew over the town twice around 6:45 a.m. on April 4, 2017. One resident said he saw the plane drop a bomb near the town's central bakery in the northern neighborhood during the first fly-over. Several people, including the person who saw the bomb falling, said they heard no explosion but saw smoke and dust rising from the area, consistent with the relatively small explosive charge in a chemical bomb. Several people also confirmed that they saw people injured or heard reports of injuries immediately after the first fly-over. A few minutes later, they said, a warplane dropped three or four high-explosive bombs on the town.

Human Rights Watch identified 90 people, including 30 children, whom local residents and activists said died due to chemical exposure from this attack. Medical personnel said the attack injured hundreds more.

Human Rights Watch reviewed dozens of photos and videos provided by residents of a crater from the impact of the first bomb. Local residents believed this site was the source of the chemical exposure because those who died lived nearby and people who came near it, including first responders, exhibited the strongest symptoms of chemical exposure. One of the first photos of the crater, taken by first responders, shows what appears to be liquid on the asphalt. That would be consistent with the use of a bomb containing sarin, which is in liquid form at room temperature.

The photos and videos of the crater show two remnants from the chemical weapon used: a twisted thin metal fragment with green paint and a smaller circular metal object. Green coloring is widely used on factory-produced weapons to signify that they are chemical weapons. A Soviet-produced, air-dropped sarin bomb exhibitied at a museum in Moscow,

for example, has two green bands. The circular object seen in photos of the crater appears similar to the cap covering the filling hole on the sarin bomb exhibited in the museum.

These remnants, combined with witness observations, the victims' symptoms, and the identification of sarin as the chemical used in the attack by the French[1] and Turkish[2] governments and the Organisation for the Prohibition of Chemical Weapons,[3] suggest that the Syrian warplane dropped a factory-made sarin bomb.

Evidence suggests that the Khan Sheikhoun attack is not the first time government warplanes have dropped nerve agents in recent months. Witnesses described to Human Rights Watch symptoms consistent with exposure to nerve agents that they and other local residents experienced after warplanes attacked eastern Hama on December 11 and 12 and northern Hama, near Khan Sheikhoun, on March 30, 2017.

The December attacks were in territory controlled by the Islamic State (also known as ISIS), which closely monitors communication, so it has been difficult to reach witnesses. But four witnesses interviewed by phone and two medical personnel interviewed via text message through intermediaries gave consistent accounts of the attacks. An opposition-affiliated activist and local residents provided the names of 64 people who died from chemical exposure in the December attacks.

The suspected nerve agent attack in northern Hama on March 30 caused no deaths, but injured dozens of people, both civilians and combatants, according to local residents, medical personnel, and first responders.

All four suspected nerve agent attacks were in areas where offensives by armed forces fighting the government threatened government military air bases.

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[1] "National Evaluation: Chemical Attack of 4 April 2017 (Khan Sheikhoun), Clandestine Syrian Chemical Weapons Programme," Government of France, April 26, 2017, http://www.diplomatie.gouv.fr/IMG/pdf/170425_-_evaluation_nationale_-_anglais_-_final_cleodbf47-1.pdf.

[2] Zehra Melek Cat, "Turkey says evidence of sarin gas in Syria attack found," AA.com.tr, April 11, 2017, http://aa.com.tr/en/middle-east/turkey-says-evidence-of-sarin-gas-in-syria-attack-found/794620 (accessed April 17, 2017).

[3] "OPCW Director-General shares incontrovertible laboratory results concluding exposure to sarin," OPCW news release, April 19, 2017, https://www.opcw.org/news/article/opcw-director-general-shares-incontrovertible-laboratory-results-concluding-exposure-to-sarin//.

Government forces' use of chlorine-filled weapons has become more widespread and systematic. During the last month of the battle for Aleppo city, which ended on December 15, 2016, helicopters dropped multiple improvised chlorine-filled munitions in a pattern showing that the attacks were part of the overall military strategy to retake the city. Such attacks have continued more recently, for example, in al-Lataminah in northern Hama.

Since January 2017, Human Rights Watch has also documented, for the first time since August 2013, the use by government or pro-government ground forces of improvised surface-fired rockets containing chlorine to attack territory near Damascus controlled by armed groups fighting the government.

Some of the chemical attacks hit residential areas far from the frontlines without any obvious military target and appear to have killed and injured only civilians, suggesting the Syrian government forces directed at least some of the attacks against the civilian population.

The Syrian government has repeatedly denied using chemical weapons, including in Khan Sheikhoun on April 4. While Russia has carried out aerial attacks in the areas where chemical attacks took place, Human Rights Watch has no information to indicate that Russian authorities have used chemical weapons. However, Russian forces continue to provide active military support to Syrian forces despite extensive evidence that the latter are using chemical weapons and targeting civilians.

The Chemical Weapons Convention, which entered into force in 1997, prohibits the development, production, stockpiling, and use of chemical weapons, and requires their destruction. The prohibitions also apply to toxic chemicals with civilian uses, such as chlorine, when they are used as weapons. Syria became a party to the convention in October 2013.

Crimes against humanity consist of specific criminal acts committed on a widespread or systematic basis as part of an "attack on a civilian population," meaning there is some degree of planning or policy to commit the crime. Such acts include murder and "other inhumane acts of a similar character intentionally causing great suffering or serious injury to body or to mental or physical health." The prohibition of crimes against humanity is among the most fundamental in international criminal law and can be the basis for

individual criminal liability in international courts, as well as in some foreign domestic courts under the principle of universal jurisdiction.

Human Rights Watch calls on the UN Security Council to immediately adopt a resolution calling on all parties to the Syrian conflict to fully cooperate with OPCW investigators and facilitate their unimpeded access to locations of chemical attacks, as required by UN Security Council resolutions 2118 and 2235. In line with the Security Council's pledges to impose measures under Chapter VII of the UN charter in the event of continued chemical weapons use in Syria, Human Rights Watch also calls on the Security Council to adopt sanctions against those responsible for chemical attacks that UN-appointed

investigations have confirmed. Human Rights Watch also urges UN member states to support the Syria accountability mechanism established by the UN General Assembly in December 2016, including by providing funds.

### Chemical Attacks Documented since December 2016

*Delivery mechanism, chemical and casualties based on best available information.
*Casualties reported as civilians unless otherwise indicated.

| Date | Location | Delivery mechanism | Chemical | Reported Casualties |
|---|---|---|---|---|
| **April 7** | Qaboun, Damascus | Unknown | Chlorine | Two injured |
| **April 4** | Khan Sheikhoun, Idlib | Warplane | Sarin | 92 killed, hundreds injured |
| **April 3** | Al-Lataminah, Hama | Helicopter | Chlorine | 12 injured |
| **March 30** | Al-Lataminah, Hama | Warplane | Nerve agent | 169 injured (possibly many of them combatants) |
| **March 29** | Qaboun, Damascus | Ground-launched rocket | Chlorine | 35 injured |
| **March 25** | Al-Lataminah, Hama | Helicopter | Chlorine | 3 killed, 32 injured |
| **February 10** | Irbin, Damascus | Unknown | Chlorine | 3 injured (combatants) |
| **February 9** | Irbin, Damascus | Unknown | Chlorine | 3 injured (combatants) |
| **January 30** | Marj al-Sultan, Damascus | Ground-launched rocket | Chlorine | 11 injured |

| | | | | |
|---|---|---|---|---|
| **January 8 and 9** | Basimah, Damascus | Unknown | Chlorine | 46 injured |
| **December 12** | Jrouh, Hama | Warplanes | Nerve agent | 25 killed |
| **December 12** | Al-Salaliyah, Hama | Warplane | Nerve agent | 42 killed |

Corrections:

The report, press release, and a graphic have been corrected to reflect the following changes:

1. Human Rights Watch identified bomb fragments from the impact crater associated with the attack as consistent with a 250 kilogram Soviet-manufactured chemical munition. We described this munition as most likely a "KhAB-250," an abbreviation of the commonly used Russian term *Khimicheskaya Aviatsionnaya Bomba*, or "Chemical Aviation Bomb." However, the official nomenclature for this class of weapon is inconsistent, and we have removed the term "KhAB-250" from the report and press release to avoid confusion. We have also updated the report to reflect that the Soviet Union produced several types of chemical munitions, rather than two types as we originally said. A new appendix sets out in further detail the available information about sarin bombs produced by the Soviet Union.
2. The original version of this report incorrectly recorded the measurements of the impact crater in the road in Khan Sheikhoun recorded by Forensic Architecture as 1.62 centimeters in diameter and 0.42 centimeters deep. The unit of measure has been corrected to be meters, not centimeters.
3. Members of the al-Youssef family and other sources provided Human Rights Watch with the names of 25 people from the al-Youssef family they believed to be dead. Two of the people on the list were injured, but survived, bringing the number of the dead to 90, not 92.

# Recommendations

Russia and China have repeatedly used their UN Security Council vetoes to block individual sanctions and a referral of the situation in Syria to the International Criminal Court (ICC). ISIS, which has also used chemical weapons, is already under UN sanctions, but so far the Syrian government has escaped accountability. The Syrian government has not fully cooperated with UN and OPCW investigations and has not provided all requested information.

## To the UN Security Council

- Immediately reiterate its demand that the Syrian government and other parties to the conflict fully cooperate with UN and OPCW investigators, including by providing requested information, as required by UN Security Council resolutions 2118 and 2235;
- Impose a travel ban and asset freeze on those in the Syrian government and military chain of command responsible for chemical attacks that UN and OPCW investigations have confirmed;
- Impose an arms embargo on the Syrian government and refer the situation in the country to the International Criminal Court (ICC).

The Syrian government has used chemical weapons on numerous occasions since at least 2013. Despite pledges to cooperate with OPCW and UN inspectors, it has withheld requested information.[4] The cases documented in this report strongly suggest that the Syrian government provided the OPCW with an incomplete declaration of its chemical weapons stocks and/or production capabilities in 2013.

## To the Syrian Government

- Immediately stop using chemical weapons;
- Fully cooperate with OPCW investigators, including facilitating access to sites of chemical attacks and provide investigators with all information they request;

[4] "Syria: Stop Undermining UN Investigation," Human Rights Watch news release, October 28, 2016, https://www.hrw.org/news/2016/10/28/syria-stop-undermining-un-investigation.

- Amend the declaration to the OPCW to reflect its remaining chemical weapons stockpile and facilities, enable the OPCW to verify and destroy both the stocks and precursors, and permanently disable any remaining chemical weapon production facilities.

## To Non-State Armed Groups

- Fully cooperate with OPCW investigators, including facilitating access to sites of chemical attacks and provide investigators with all information they request.

Both Russia and Iran are close military allies of the Syrian government and are therefore in a position to influence military decision-making. This close alliance also raises the possibility that Russian and Iranian military personnel could have been aware of the Syrian government's use of chemical weapons. In the case of the battle for Aleppo in late 2016, the government repeatedly used chlorine in a pattern that appeared coordinated with the military strategy to retake the city. Both Russia and Iran participated in that battle, Russia in the air, and Iran on the ground.

## To the Russian Government

- As required by UN Security Council resolution 2235, assist the UN and OPCW in investigating the origin of any Soviet or Russian-made munitions that may have been used in Khan Sheikhoun or any other chemical attacks;
- Stop using the veto to block an ICC referral and individual sanctions on senior Syrian government and military personnel credibly implicated in past chemical attacks confirmed by the UN and OPCW;
- As an essential military partner, put pressure on the Syrian government to stop using chemical weapons and fully cooperate with UN and OPCW investigators, as required by UN Security Council resolutions 2118 and 2235;
- Ensure that Russian military personnel cease cooperation with all Syrian military personnel and units suspected of involvement in chemical attacks and other serious crimes.

## To the Iranian Government

- As a close ally and whose citizens were once victims of chemical weapons, put pressure on the Syrian government to stop using toxic agents and fully cooperate with UN and OPCW investigators;
- Ensure that Iranian military personnel and allied militias cease cooperation with all Syrian military personnel and units suspected of involvement in chemical attacks.

Because Russia and China repeatedly vetoed resolutions referring the situation in Syria to the ICC, the UN General Assembly, in December 2016, created a mechanism to assist in the investigation and prosecution of those responsible for the most serious crimes under international law in Syria.[5] In response to findings by the OPCW that chlorine had been used in attacks in Syria in 2014, the UN Security Council established a UN-OPCW Joint Investigative Mechanism to identify perpetrators where the OPCW determined that an incident involved or likely involved the use of chemicals. In line with the provisions of Security Council resolution 2235, all UN member states are required to cooperate with the joint mechanism.

## To UN Member States

- Support and fund the International, Impartial, and Independent Mechanism created by the UN General Assembly to assist in the investigation and prosecution of those responsible for the most serious crimes under international law in Syria;
- Support ongoing documentation efforts by the UN Commission of Inquiry on Syria into serious crimes by all sides to the conflict;
- Provide UN and OPCW investigators with any and all information and intelligence on chemical attacks in Syria to support their investigations, as required by UN Security Council resolution 2235;
- Investigate and prosecute individuals suspected of committing serious crimes under the principle of universal jurisdiction and in accordance with national laws;
- Take all available steps to encourage Russia to drop its opposition to the ICC's involvement in Syria, including by publicly stating support for an ICC referral;

[5] "Syria: UN General Assembly Adopts Resolution on War Crimes Investigations," Human Rights Watch news release, December 21, 2016, https://www.hrw.org/news/2016/12/21/syria-un-general-assembly-adopts-resolution-war-crimes-investigations.

- Publicly condemn Syria's violations of international humanitarian, criminal, and human rights law;
- Acting individually, or jointly through regional mechanisms where appropriate, adopt, maintain, or strengthen targeted sanctions against Syrian officials credibly implicated in the ongoing serious violations.

## To the UN-OPCW Joint Investigative Mechanism

- The UN-OPCW Joint Investigative Mechanism should investigate whether any other governments, including Syria's military allies Russia and Iran, aided or abetted the use of chemical weapons by Syrian government forces. Parties to the Chemical Weapons Convention are prohibited from doing anything that could assist, encourage, or induce violation of the convention.

## To Member States of the Chemical Weapons Convention

- Move to restrict or suspend Syria's rights and privileges as a member due to its repeated violations of the treaty;
- Convene a special session on Syria's repeated violations of the treaty and move to recommend that the UN Security Council impose individual sanctions on those in Syria's government and military responsible for the use of chemical weapons.

# Methodology

For the cases described in this report, Human Rights Watch interviewed 60 people with first-hand knowledge of the attacks and their immediate aftermath, including victims, witnesses, first responders, journalists, local opposition-affiliated activists, and medical personnel. Human Rights Watch also consulted experts on chemicals and weapons. Human Rights Watch interviewed eight witnesses to the Khan Sheikhoun attack in person in Turkey, the rest by phone. Human Rights Watch was unable to conduct on-the-ground investigations on any of the attack sites.

Human Rights Watch identified the witnesses through existing contacts in the area or by reaching out to people who posted information about the attacks on social media. Almost all of the interviews were conducted in Arabic. Human Rights Watch gave interviewees the option of requesting that identifying information be omitted if they were worried about their security. The report contains identifying information only if the interviewee agreed to publication of such information and if Human Rights Watch did not separately assess that it would put the interviewee at risk.

To corroborate information from witnesses, Human Rights Watch reviewed photos and videos posted online and shared directly by witnesses, in particular to see whether clinical signs and symptoms were consistent with witness statements and exposure to chemicals. Keith Ward, an independent expert on the detection and effects of chemical warfare agents, reviewed and assess information about clinical signs and symptoms witness statements, videos, and photos.

Human Rights Watch also obtained photos and videos of remnants of the munitions used in the attacks. Specialists in weapons identification and chemical weapons inside and outside the organization analyzed the remnants. Forensic Architecture, a group specializing in spatial analysis, created a model of a crater related to the Khan Sheikhoun attack from videos and photos, allowing for exact measurement of its size.

Human Rights Watch has not had access to Syrian government documentation or interviewed government or military officials.

# I. Legal Framework: Chemical Weapons

Several international treaties prohibit the use of chemical weapons, including the 1899 Hague Declaration concerning Asphyxiating Gases, the 1925 Geneva Gas Protocol, the 1993 Chemical Weapons Convention, and the 1998 Statute of the International Criminal Court. The International Committee of the Red Cross considers the prohibition a norm of customary international law applicable in both international and non-international armed conflict.[6]

The Chemical Weapons Convention, which entered into force in 1997, prohibits the development, production, stockpiling, and use of chemical weapons, and requires their destruction. The prohibitions of the convention also apply to toxic chemicals, such as chlorine, when they are used as weapons. With 192 state parties, the Chemical Weapons Convention is the most universal weapon ban in international law. Only four member states of the UN are not parties: Egypt, Israel (signatory), North Korea, and South Sudan. Syria became a party to the convention in October 2013.[7]

The UN Security Council has condemned the use of chemical weapons in Syria. After a UN investigation found that sarin had been used in the August 2013 attack in Ghouta near Damascus, the UN Security Council condemned in the strongest terms any use of chemical weapons in Syria and decided that "the Syrian Arab Republic shall not use, develop, produce, otherwise acquire, stockpile or retain chemical weapons, or transfer, directly or indirectly, chemical weapons to other States or non-State actors."[8] The UN Security Council also said that it would impose measures under Chapter VII of the United Nations Charter, in the event of non-compliance with the resolution, "including unauthorized transfer of chemical weapons, or any use of chemical weapons by anyone in the Syrian Arab Republic."[9] The UN Security Council similarly condemned the use of chemical weapons in Syria in subsequent resolutions.

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[6] "Rule 74: Chemical Weapons," ICRC, Customary IHL, https://ihl-databases.icrc.org/customary-ihl/eng/docs/v1_rul_rule74.

[7] "Status of Participation in the Chemical Weapons Convention as at 17 October 2015," OPCW, October 19, 2015, https://www.opcw.org/about-opcw/member-states/status-of-participation/.

[8] United Nations Security Council, Resolution 2118 (2013), S/RES/2118 (2013) http://www.securitycouncilreport.org/atf/cf/%7B65BFCF9B-6D27-4E9C-8CD3-CF6E4FF96FF9%7D/s_res_2118.pdf, art. 4.

[9] Ibid., art. 21.

Under customary international law and the Rome Statute of the International Criminal Court, crimes against humanity are certain acts, including murder, and other inhumane acts of a similar character, intentionally causing great suffering, or serious injury, committed as part of a widespread or systematic attack against a civilian population.

The Rome Statute defines an "attack against a civilian population" as a course of conduct involving the multiple commission of criminal acts such as murder or other possible crimes against humanity against any civilian population, pursuant to or in furtherance of a State or organizational policy to commit such attack.[10]

The use of prohibited weapons with criminal intent, deliberately or recklessly, is a war crime.

[10] Rome Statute of the International Criminal Court, adopted July 17, 1998, A/CONF.183/9, entered into force July 1, 2002.

# II. Helicopter-Delivered Munitions

Human Rights Watch has documented repeated instances in which Syrian government helicopters dropped improvised munitions filled with chlorine since April 2014.[11] A Joint Investigative Mechanism between the UN and the OPCW also concluded, in a report published on October 21, 2016, that Syrian government forces had used chlorine as a weapon in three incidents in 2014 and 2015.[12] The investigation determined that helicopters from Syria's 63rd helicopter brigade, operating from Hama and Hmeimim airbases, carried out the attacks.

During the final month of the battle for Aleppo in late 2016, government helicopters dropped chlorine-filled improvised munitions on at least eight occasions. The attacks appeared coordinated with the military strategy for retaking the city.[13] In addition to the eight attacks in Aleppo, Human Rights Watch documented two recent attacks in which government helicopters dropped chlorine-filled munitions. These attacks killed 12 civilians due to chlorine exposure, and injured hundreds.

Government forces have used several types of helicopter-delivered chlorine-filled improvised munitions. In some cases, the munitions consisted of oil barrels filled with a variety of chemical containers and explosives. In other cases, and more common recently, helicopters have dropped large, yellow-colored gas cylinders. Local residents often refer to the chlorine-filled improvised munitions dropped from helicopters as barrels or barrel bombs.

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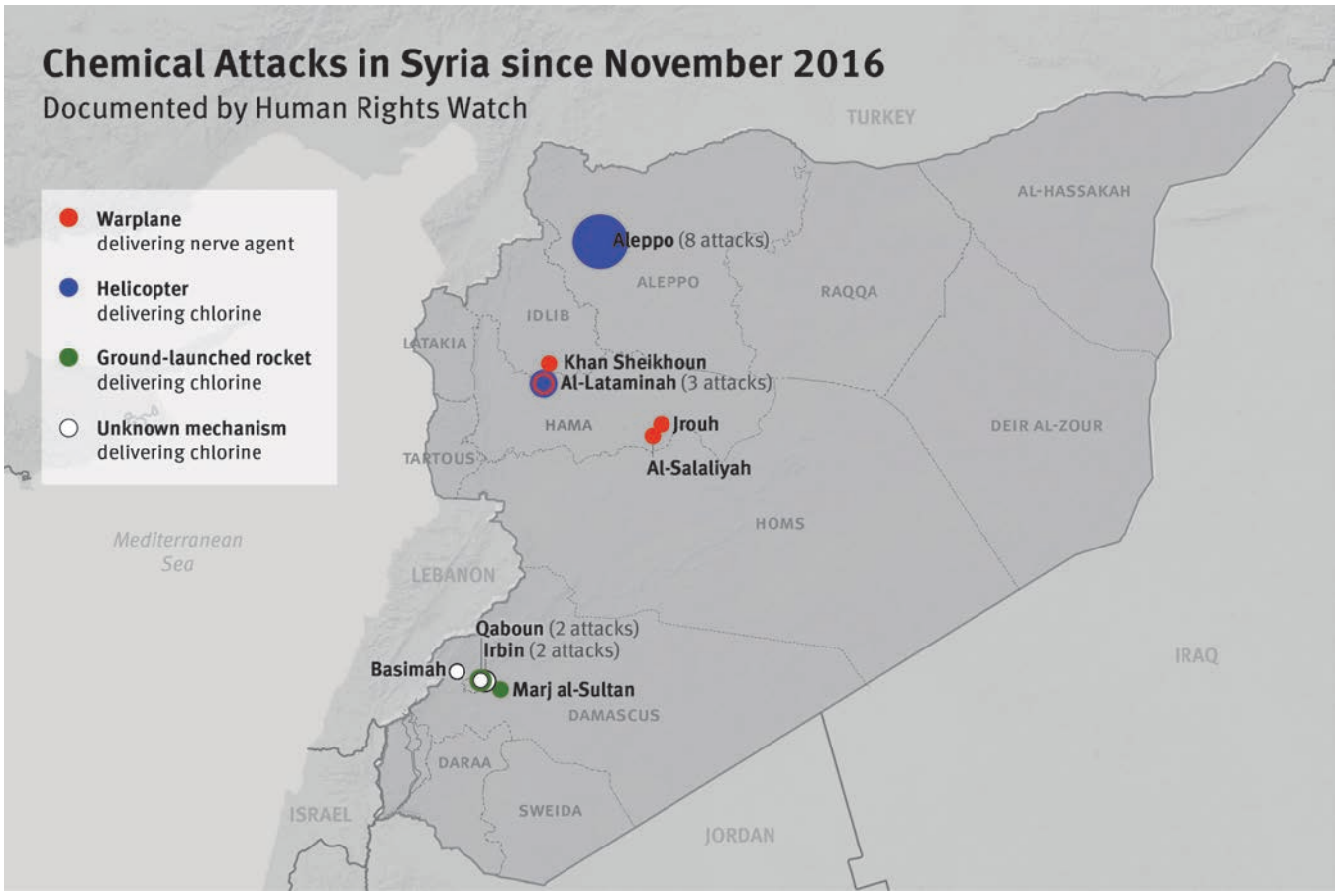
[11] "Syria: Strong Evidence Government Used Chemicals as a Weapons," Human Rights Watch news release, May 13, 2014, https://www.hrw.org/news/2014/05/13/syria-strong-evidence-government-used-chemicals-weapon; "Syria: Chemicals Used in Idlib Attacks," April 13, 2015, https://www.hrw.org/news/2015/04/13/syria-chemicals-used-idlib-attacks; "Syria: New Chemical Attacks in Idlib," June 3, 2015, https://www.hrw.org/news/2015/06/03/syria-new-chemical-attacks-idlib; "Syria: New Deadly Chemical Attacks," September 28, 2016, https://www.hrw.org/news/2016/09/28/syria-new-deadly-chemical-attacks.

[12] Organization for the Prohibition of Chemical Weapons, "Fourth Report of the Organization for the Prohibition of Chemical Weapons – United Nations Joint Investigative Mechanism," S/2016/888, October 21, 2016, http://www.securitycouncilreport.org/atf/cf/%7B65BFCF9B-6D27-4E9C-8CD3-CF6E4FF96FF9%7D/s_2016_888.pdf.

[13] "Syria: Coordinated Chemical Attacks on Aleppo," Human Rights Watch news release, February 13, 2017, https://www.hrw.org/news/2017/02/13/syria-coordinated-chemical-attacks-aleppo.




Pure chlorine is a pale, yellowish-green gas, and witnesses often report seeing an unusual “yellow smoke” at the attack site, which is consistent with the release of chlorine gas from the rupture of industrial compressed gas cylinders. Chlorine gas also has a distinct odor, which witnesses recognize as household cleaning products containing bleach as well as from frequent use of improvised chlorine munitions in Syria.

Mild exposure to chlorine causes reddening and itchiness of the eyes and difficulty seeing. More severe exposure leads to breathing difficulties and complaints of shortness of breath. Even higher levels of exposure can lead to vomiting, severe respiratory distress, uncontrollable coughing, and even suffocation, as the chemical injuries inflicted by the hydrochloric and hypochlorous acids produced from the dissolution of chlorine in the pulmonary airways result in severe buildup

## Remnants of Chemical Munitions

Aleppo, November 17-December 13, 2016

**During the final weeks of the battle for Aleppo, Syrian government helicopters repeatedly dropped gas cylinders filled with chlorine, affecting hundreds of civilians.** Journalists, first responders and activists photographed and filmed remnants from at least seven yellow cylinders in different locations.

**Masaken Hanano, Aleppo,**
November 18, 2016
© 2016 Aleppo Media Center

**Al-Sakhour, Aleppo,**
November 20, 2016
© 2016 Syria Civil Defense

**Tariq al-Bab, Aleppo,**
November 20, 2016
© 2016 Syrian Institute for Justice and Accountability

**Karm al-Jazmati, Aleppo,**
November 23, 2016
© 2016 Omar Arnaout

**Karm al-Qaterji, Aleppo,**
November 28, 2016
© 2016 Firas Badawi

**Found in Aleppo**
on December 8, 2016
© 2016 Private

**Found in Bustan al-Qasr, Aleppo,**
on December 10, 2016
© 2016 Private

of fluid in the lungs. The sensation would be similar to that of drowning. High levels of chlorine exposure can be deadly.

## Al-Lataminah, April 3

On April 3, 2017, a helicopter appears to have dropped at least one munition with chlorine on al-Lataminah, a town about 15 kilometers southwest of Khan Sheikhoun that used to have about 30,000 residents before the war, but now has many fewer, according to a local journalist, a first responder, and a local resident, each of whom Human Rights Watch interviewed, as well as a statement by the opposition-run Idlib Health Directorate.

Fayed al-Satouf, a local journalist in al-Lataminah, told Human Rights Watch that the sentries, a network of monitors tracking aircraft movement, reported a helicopter above al-Lataminah on the evening on April 3. Because he documents airstrikes, he said, he went out to follow it. Around 9:45 p.m., the helicopter dropped two barrels about 300 meters away from him, he said:

> I could smell the chlorine gas. My chest felt tight, like I was suffocating. Also, my eyes started reacting like I was having an allergic reaction. And my body was shaking. The smell got stuck inside my nose all night. It was like I was breathing chlorine. It's like what we use at home for cleaning toilets.[14]

A local resident who was close to the impact site also described smelling chlorine:

> I got dizzy; my eyes started tearing, and my chest became heavy. I started choking, and then I collapsed. I don't know what happened next, but I woke up in the hospital. I stayed sick for two days, coughing.[15]

Al-Satouf said that the chlorine exposure injured 12 people, including women and children. Munaf al-Saleh, the al-Lataminah head of Syria Civil Defense, a search and rescue group operating in territory controlled by armed groups fighting the government, also said that two chlorine barrels hit the village in the evening on April 3, injuring about 12 civilians.[16] During a filmed press conference, the director of the opposition-run Idlib Health Directorate said that the April 3 attack injured 22 people.[17]

Al-Saleh said that the barrels that landed on April 3 had a similar odor to those he found after the March 25 attack on al-Lataminah hospital (see below).

## Al-Lataminah Hospital, March 25

On March 25, 2017, a helicopter dropped at least one improvised munition filled with chlorine on a makeshift hospital in al-Lataminah, a village in the northern Hama countryside, according to five witnesses whom Human Rights Watch interviewed, and photographs of remnants of munitions.

According to Dr. Mahmoud al-Mohammad, the manager of the hospital in al-Lataminah, because previous attacks had twice hit buildings used as hospitals in the village, they had

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[14] Human Rights Watch telephone interview with Fayed al-Satouf, April 11, 2017.

[15] Human Rights Watch telephone interview with local resident (name withheld), April 21, 2017.

[16] Human Rights Watch telephone interview with Munaf al-Saleh, head of al-Lataminah Syria Civil Defense, April 13, 2017.

[17] "Dr. Munther Khalil, Director of Idlib Health Directorate…" (الدكتور منذر خليل مدير صحة ادلب يتحدث عن الغارات الجوي المحملة بغاز السارين والتي استهدفت خان شيخون), April 4, 2017, video clip, YouTube, https://www.youtube.com/watch?v=p-GhbtRn450&feature=youtu.be (accessed April 14, 2017).

moved the hospital to a building outside the village and reinforced the roof with steel covered by soil.

Dr. al-Mohammad, who said he arrived at the hospital shortly after the attack, told Human Rights Watch that the attack happened around 3 p.m. on March 25. A helicopter dropped two barrels, he said. One barrel with explosives fell about fifty meters from the hospital, the other hit the roof of the hospital.[18]

"Alaa," the hospital anesthesiologist, told Human Rights Watch that he stepped out of the hospital to check on a patient who had just arrived with a head wound when an object crashed through the hospital's roof: "Within two or three seconds, gas started spreading and caused suffocation among all medical staff. It had a yellow color. It caused tearing in the eyes, nose, and mouth."[19]

"Bilal," a nurse, said: "We were shocked when the barrel managed to pierce the reinforced roof. The smell of chlorine was very strong. Its color was yellow and voluminous. It wasn't the first time we were hit with chlorine. So we knew what it was. But this time, the smell was stronger than usual."[20]

Dr. al-Mohammad, the hospital manager, said that the attack killed three people due to chlorine exposure: Dr. Ali Darwish, the hospital's orthopedic surgeon who was conducting a surgery at the time of the attack, the patient in surgery, and one first responder. The chlorine seriously injured Dr. Darwish's assistant, who was still receiving treatment in Turkey as of April 8. In total, 32 people suffered medium to critical injuries due to the chlorine exposure.[21] Abd al-Munaf Faraj al-Saleh, the head of Syria Civil Defense in al-Lataminah, confirmed that the attack killed three people.[22]

[18] Human Rights Watch telephone interview with Dr. Mahmoud al-Mohammad, April 8, 2017.
[19] Human Rights Watch telephone interview with "Alaa," hospital employee, April 8, 2017.
[20] Human Rights Watch telephone interview with "Bilal," hospital employee, April 8, 2017.
[21] Human Rights Watch telephone interview with Dr. Mahmoud al-Mohammad, April 8, 2017.
[22] Human Rights Watch telephone interview with Abd al-Munaf Faraj al-Saleh, April 8, 2017.

A local journalist said he went to the hospital immediately after the attack and that there was a strong smell of chlorine when he arrived.[23] "Hatem," a hospital employee, said that he did not hear any helicopter sound prior to the attack, but heard sentry reports over the radio that two helicopters were in the air nearby.[24]

While witnesses gave different information as to how many gas cylinders struck the hospital and surrounding area, there are photos of at least two different cylinders. Munaf al-Saleh from Syria Civil Defense shared a photo of a deformed yellow gas cylinder that he said was the one that had hit the hospital roof.[25] A reverse image search indicated that the photo had not been published online anywhere before.

Remnant of yellow gas cylinder that struck a make-shift hospital in al-Lataminah on March 25, 2017 according to a Syria Civil Defense member. Photo shared by © 2017 Abd al-Munaf Faraj al-Saleh

Thiqa News Agency, a pro-opposition news source, posted a video on YouTube of what it said was the hospital with a hole in the roof and a yellow gas cylinder in a pile of rubble.[26] Syria Civil Defense also posted photos on Twitter of a gas cylinder that they said fell near the hospital.[27] The cylinder that Thiqa News Agency and Syria Civil Defense posted online

[23] Human Rights Watch telephone interview with Fayed al-Satouf, April 11, 2017.

[24] Human Rights Watch telephone interview with "Hatem," hospital employee, April 13, 2017.

[25] Photo on file with Human Rights Watch.

[26] "The moment…" ("لحظة إلقاء الطيران المروحي براميل غاز الكلور على مشفى اللطامنة وخروجه عن الخدمة"), March 26, 2017, video clip, YouTube, https://www.youtube.com/watch?v=9MCiIMFG1uU (accessed April 13, 2017).

[27] Tweets from the Twitter account of Syria Civil Defense, March 25, 2017, https://twitter.com/SyriaCivilDef/status/845712375462420480 (accessed April 14, 2017); March 26, 2017, https://twitter.com/SyriaCivilDef/status/846053794303660032 (accessed April 13, 2017).

appears different from the one in the photo that al-Saleh provided, which could reflect the use of multiple cylinders.

The opposition-run Hama Health Directorate released a statement in the evening of March 25 saying that a barrel bomb containing chlorine gas had hit al-Lataminah hospital, killing Dr. Darwish.[28]

[28] Announcement from the Hama Health Directorate, March 25, 2017, https://www.facebook.com/latamenh.h2/photos/a.655052357992256.1073741828.654197224744436/777807462383411/?type=3&theater (accessed April 13, 2017).

# III. Warplane-Delivered Munitions

Human Rights Watch has documented four attacks since December 12, 2016, in which government warplanes appear to have carried out aerial attacks with nerve agents, a group of chemicals that includes sarin: on Jrouh and al-Salaliyah in eastern Hama governorate on December 12, 2016; near al-Lataminah village in Hama governorate on March 30; and on Khan Sheikhoun in Idlib governorate on April 4. Human Rights Watch has identified 159 people who reportedly died in the four attacks from chemical exposure. Hundreds were injured.

Evidence shows that local residents were exposed to toxic chemicals. In all four attacks, witnesses, including medical personnel, described clinical signs and symptoms that indicate exposure to toxic chemicals. For two of the attacks, Human Rights Watch reviewed photos taken after the attack showing injured people with constricted pupils. In all four attacks, first responders and others trying to help said they began to manifest the clinical signs and symptoms of exposure to chemicals when they came near the impact sites. Such examples of "secondary exposure" are characteristic of the presence of a nerve agent, such as sarin. Some symptoms suggest that other toxic chemicals were present as well.

With regards to the Khan Sheikhoun attack, Turkish authorities have said that analysis of biomedical samples from four victims who received treatment in Turkey showed the presence of a degradation product of sarin. OPCW has said that analysis of biomedical samples from victims showed the presence of "sarin or sarin-like substances."

The evidence regarding what toxic chemical was used is less conclusive for the December 12 attacks in eastern Hama. Many of the clinical signs and symptoms are consistent with exposure to nerve agents, including one doctor's statement that he observed pinpoint pupils. The other witnesses, however, said that injured people had dilated, not constricted pupils. Dilated pupils can sometimes be seen when victims are exposed to high levels of nerve agents, depending upon the route of exposure, but it is not a common symptom.

The evidence also indicates that warplanes dropped the toxic chemicals. In all four cases, witnesses heard or saw warplanes in the vicinity immediately before the explosions. For each of the attacks, Human Rights Watch interviewed at least one witness who saw the

warplane drop the suspected chemical bomb. In all four attacks, witnesses say they became sick immediately after the bombs impacted. In all four cases, some of the witnesses said that at least one explosion was less loud than the sound they normally hear from the use of explosive weapons, which would be consistent with the smaller detonation of the bursting charge in a chemical bomb.

For the Khan Sheikhoun attack, photos and videos of weapon remnants, posted online and provided to Human Rights Watch by local residents, as well as the identification of sarin as the chemical used, suggest that the warplane dropped a factory-made sarin bomb. The Syrian government's use of such bombs would mean it retained some of its chemical weapons despite the UN Security Council's demand and its obligation under the Chemical Weapons Convention to declare and destroy them. Human Rights Watch has not found photos of fragments from the other three attacks that would allow it to identify a weapon.

Human Rights Watch found no evidence to support claims by Syrian and Russian officials that a high-explosive bomb had struck a chemical weapons production facility or chemical weapons depot in the vicinity in the April 4 Khan Sheikhoun attack. Human Rights Watch also did not find evidence to support claims that armed groups on the ground had detonated a chemical weapon, causing the chemical exposure.

That government warplanes appear to have conducted chemical attacks on three different dates in four different locations undermines Syrian and Russian officials' claims that the chemical exposure in Khan Sheikhoun was due to an airstrike hitting a chemical weapons production facility or depot on the ground. That, and the fact that ISIS controlled two of these locations and other groups fighting ISIS controlled the two others, makes it highly unlikely that an armed group staged the attacks.

## Khan Sheikhoun, April 4

All evidence reviewed by Human Rights Watch suggests that a Syrian government warplane dropped a bomb with sarin on Khan Sheikhoun around 6:45 a.m. on April 4, 2017, killing at least 92 people and injuring hundreds. Human Rights Watch interviewed 32 witnesses of the Khan Sheikhoun attack, eight in person in Turkey, and the rest by telephone. Human Rights Watch also reviewed satellite imagery; photos and videos of the victims, the impact

site, weapon remnants, and the immediate aftermath of the attack; and information about aircraft movements.

Khan Sheikhoun, a town in southern Idlib, has been under the control of armed groups fighting the government since 2012. Local residents estimated that there were about 60,000 people in the town at the time of the attack, many of them displaced from other places due to the war.

The Khan Sheikhoun attack and chemical attacks on and near al-Lataminah took place in the context of heavy fighting near Hama city, about 20 kilometers south of al-Lataminah and 35 kilometers south of Khan Sheikhoun. On March 21, armed groups led by Hay'at Tahrir al-Sham launched an offensive against government positions near Hama. Over the next several days, the anti-government forces made significant advances, coming within three kilometers of the city and threatening the Hama Military Airport. By the time of the Khan Sheikhoun attack, the battle was still raging back and forth.

Local residents told Human Rights Watch that they heard or saw a warplane fly over Khan Sheikhoun early in the morning on April 4. Several witnesses said that the warplane flew over the town twice, dropping a chemical bomb the first time and explosive bombs the second time.

Ahmad al-Helou, who was tending the fields that morning, told Human Rights Watch that he looked up when he saw a shadow on the ground and saw a plane fly towards Khan Sheikhoun from the east. Al-Helou said that because of his high vantage point he saw the plane drop a bomb and the bomb falling until it hit the ground. The bomb fell in front of the bakery, he said. Al-Helou said that he did not hear an explosion, but that he saw the bomb kick up yellowish smoke that spread in the prevailing wind.[29]

Other witnesses gave similar accounts. Ismail Raslan, a Syria Civil Defense member who lived about 100 meters from the bakery, told Human Rights Watch that he heard a warplane fly over some time after 6:30 a.m. He told Human Rights Watch: “I heard the wind and the roar from a bomb falling, but there was no explosion, just a thump. I thought that it

[29] Human Rights Watch telephone interview with Ahmad al-Helou, April 20, 2017.

either fell far away or failed to explode. I looked out from the balcony and was surprised to see white dust in the air."[30]

Adham al-Hussein, a local journalist, told Human Rights Watch that he woke up when sentries and the Syria Civil Defense reported over the radio network that a warplane was heading north from the Shayrat airbase in Homs. At 6:37 a.m., he said, he heard the warplane fly over Khan Sheikhoun. He went to the roof of his building where he saw the plane fly away towards the north. Over the radio, one of the sentries said that the warplane had not attacked because there was no explosion, but al-Hussein could see white smoke over the northern neighborhood. From his roof, al-Hussein filmed the smoke, which he showed to Human Rights Watch.[31]

Raslan, the Syria Civil Defense member, said that he was reporting that there had been no explosion to the civil defense center when he saw a child in the street. "He ran ten meters, then collapsed. He got up, trying to run, but collapsed again," said Raslan, who then asked the civil defense center to send an ambulance.[32]

A Syria Civil Defense member at the base confirmed that they heard no explosions during the first fly-over, but that a colleague had called for an ambulance: "We got a call from one of our colleagues living in the northern neighborhood who asked us to send ambulances because there were unconscious people on the ground. We were surprised because we had not heard any explosions." He said that they immediately sent a team to the area.[33] Mohammad Juneid, a Syria Civil Defense member who was on the team, confirmed that they were dispatched to the northern neighborhood immediately after the first fly-over.[34] Al-Hussein also said there were radio reports of injured after the first fly-over.[35]

A few minutes after the first attack, and while the Syria Civil Defense team was on its way to the northern neighborhood, a plane flew over Khan Sheikhoun in the same direction,

[30] Human Rights Watch telephone interview with Ismail Raslan, April 21, 2017.

[31] Human Rights Watch telephone interview with Adham al-Hussein, April 7, 2017.

[32] Human Rights Watch telephone interview with Ismail Raslan, April 21, 2017.

[33] Human Rights Watch telephone interview with a Syria Civil Defense member (name withheld), April 4, 20, and 21, 2017.

[34] Human Rights Watch telephone interview with Mohammad Juneid, Syria Civil Defense member, April 21, 2017.

[35] Human Rights Watch telephone interview with Adham al-Hussein, April 7, 2017.

Composite of screenshots from video of the immediate aftermath of the attack during the second fly-over showing four smoke columns. Bellingcat, a group specializing in analyzing information posted online, including videos and photographs, has concluded that the video was filmed from a location to the north of Khan Sheikhoun. © 2017 Mohammad Saloum/Bellingcat

from east to west, witnesses said. It is not clear whether it was the same plane. This time, the plane dropped three or four high explosive bombs on the town.

Al-Hussein said that the plane dropped two bombs in the northern neighborhood, both to the west of the bakery. These two bombs created loud explosions. The plane then dropped another bomb about one kilometer from the others, near the market area. He filmed plumes of smoke from the three strikes during the second fly-over, which he showed to Human Rights Watch.[36]

The Syria Civil Defense member said: "The second attack was with three or four vacuum bombs, which we can tell because the explosions were so strong. We're not sure [if it was three or four bombs] because they fell almost at the same time. They could be heard all over, and shook the city." Mohammad Saloum, a local journalist, filmed the immediate aftermath of the second fly-over and posted a video on YouTube showing four smoke columns rising from Khan Sheikhoun.[37]

Through interviews with local residents, and analysis of photographs and video footage posted on the internet and provided by local residents and satellite imagery, Human Rights Watch identified three impact sites in the northern neighborhood: in the middle of

[36] Human Rights Watch telephone interview with Adham al-Hussein, April 7, 2017. Video on file with Human Rights Watch.

[37] "The moment Khan Sheikhoun was targeted…" (لحظة استهدف مدينة خان شيخون بالقنابل السامة من قبل الطيران السوري), April 3, 2017, video clip, YouTube, https://www.youtube.com/watch?v=MYOMEDK_uVs (accessed April 17, 2017). The date of publication on YouTube is April 3, 2017, the day before the Khan Sheikhoun attack. YouTube assigns all videos a date based on the time in California when the upload begins. Because California is 10 hours behind Syria, videos uploaded before 10 a.m. in Syria will be given the previous day's publication date. The timestamp of the video shows that it was uploaded at 7:59 a.m. local time on April 4, so about an hour after the attack.

a paved road close to the central bakery ("Impact Site 1"); the house of the al-Omar family ("Impact Site 2"), about 240 meters southwest; and near Mustafa al-Youssef's house ("Impact Site 3"), another 100 meters southwest. All three sites are visible on satellite imagery from April 6.

Information about aircraft movements corroborate claims that a warplane flew over Khan Sheikhoun twice. Human Rights Watch reviewed an audio recording of a sentry message, which said a warplane took off from the Shayrat airbase at 6:26 a.m.[38] In addition, the US government released a map that it says plots the flight path of a Syrian warplane that took off from the Shayrat airbase and flew over Khan Sheikhoun at two different times, 6:37 and 6:46 a.m.[39]

Many local residents said that they woke up or became aware of the attacks only when they heard the loud explosions after the second fly-over. Many said they immediately felt sick. A young teacher who lived about 300 meters from the bakery told Human Rights Watch that she woke up from the sound of a loud explosion that blew the windows in her house open:

> It felt like the air had weight. It got harder to breath; tears were running down our faces, and our eyes were burning. My son, who is one year and ten months, was running around. I couldn't see because of the tears. He was screaming "mom, dad!"[40]

Fatima Abdel-Latif al-Youssef, who lived about 100 meters west of bakery, said:

> My cousin went to the balcony. She is 16, and she was choking. I tried to help her. We poured water on her but she passed out. My aunt passed out. At that point I also passed out, but I came to later. My uncle's wife, who lives in the same building, knocked on the door of the apartment. She said, "let me in, help me!" I tried to drag her in, but I couldn't carry her because I

[38] Audio recording of the sentry message on file with Human Rights Watch.

[39] Luis Martinez and Paul Blake, "US releases flight path of plane used in Syria chemical attack," *ABC News*, April 7, 2017, http://abcnews.go.com/International/us-releases-flight-path-plane-syria-chemical-attack/story?id=46651125.

[40] Human Rights Watch telephone interview with local resident (name withheld), April 5, 2017.

> am small and she was heavy. I left her on the floor by the door to go up to the second floor, to get my uncle to come and help me…[He] went down to help her, but he never came back.[41]

Fatima and her cousin, who lived in the same home, said that seven people in the house died during the attack due to chemical exposure, including Fatima's uncle, Abdul Kareem al-Youssef; his wife; Fatima's uncle, Yasser al-Youssef; his wife, Sanaa Haj Ali; two of their children Mohamed, 10, and Ammar, 7, and Fatima's cousin Shaimaa Ibrahim al-Jawhar, 16.[42]

A doctor at a hospital that received many of the injured said that the symptoms included constriction of the pupils, trembling, sweating, extreme respiratory excretions, foaming of the mouth, and pale skin color.[43]

First responders and people trying to evacuate victims said that many suffered the same symptoms. Raslan, the Syria Civil Defense member who lived near the bakery, said that he eventually lost consciousness: "My chest got tight, and I had no breath left. I wanted to stand up but couldn't. Then I lost consciousness. I did not wake up until 11 hours later in the hospital."[44]

Abdelaziz al-Youssef, who said he arrived near the bakery to help his relatives five minutes after the attacks, said:

> People were trying to flee, moving into basements. But as they walked, they collapsed. And those who came to their help collapsed as well. The gas spread up to 500 or 600 meters. Casualties were not only in the place that was hit. There were martyrs over the entire neighborhood. Those who stayed asleep did not wake up. Those who were in basements suffocated and died. Those who woke up and went out were affected. I swear, those

[41] Human Rights Watch interview with Fatima Abdel-Latif al-Youssef, Antakya, Turkey, April 9, 2017.
[42] Ibid.
[43] Human Rights Watch telephone interview with doctor (name withheld), April 4, 2017.
[44] Human Rights Watch telephone interview with Ismail Raslan, April 21, 2017.

> who survived can't describe what happened. It was like Judgment Day — people were collapsing everywhere.[45]

Seeing that the bombs had hit his neighborhood, al-Helou, the witness who saw the bomb land in front of the bakery, at Impact Site 1, went there to see what had happened:

> People had blood and foam coming out of their mouths, and there was a strong smell. The smell was really disgusting, but I am not able to compare it to anything else. We helped one person and then another, but then we passed out as well. I don't know what happened next. I woke up in the hospital.[46]

Members of the Syria Civil Defense team that responded to reports of injured after the first fly-over were also injured. Juneid, one of the team members, said that they started to suspect the use of chemicals when they found a man unconscious in his car on their way towards the bakery, near Impact Site 1. They decided to return to the base to get protective equipment. On the way, they saw a woman in the street: "Blood was coming from her mouth. As I tried to pull her up, I started shaking. I couldn't see anymore, and then I lost consciousness. I woke up in the civil defense center."[47] A civil defense member at the base confirmed: "One of the volunteers called me saying 'I'm sleepy. I'm losing consciousness. I don't know what they hit us with.' And then we lost connection."[48]

Clinical signs and symptoms that witnesses described, especially constricted pupils, indicate exposure to a nerve agent. Recep Akdağ, the Turkish minister of health, said that analysis of blood and urine samples from four victims who received treatment in Turkey showed the presence of isopropyl methylphosphonic acid, a degradation product of sarin.[49] Referring to victims of the Khan Sheikhoun attack, the OPCW said that four different OPCW-designated hospitals analyzed bio-medical samples from three victims

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[45] Human Rights Watch telephone interview with Abdelaziz al-Youssef, April 6, 2017.

[46] Human Rights Watch telephone interview with Ahmad al-Helou, April 20, 2017.

[47] Human Rights Watch telephone interview with Mohammad Juneid, Syria Civil Defense member, April 21, 2017.

[48] Human Rights Watch telephone interviews with Syria Civil Defense member (name withheld), April 4, 20, 21, 2017.

[49] Zehra Melek Cat, "Turkey says evidence of sarin gas in Syria attack found," AA.com.tr, April 11, 2017, http://aa.com.tr/en/middle-east/turkey-says-evidence-of-sarin-gas-in-syria-attack-found/794620 (accessed April 17, 2017).

during their autopsies and from seven individuals undergoing treatment, and that the results indicated exposure to "sarin or a sarin-like substance."[50]

Witnesses consistently said that those affected by chemical exposure were in the northern neighborhood and that those exhibiting the strongest symptoms were located near the bakery, or Impact Site 1. This is also consistent with al-Hussein's account. He said that he saw smoke in the northern neighborhood after the first fly-over. When he heard that people had been injured, he immediately went to help. As he was moving towards the bakery, near Impact Site 1, he helped several people along the way who were shaking, had trouble breathing, and had foam coming from their mouths. About 20 minutes after the first attack, he said, he was around 200 meters from the bakery at Impact Site 1: "It looked like it was winter, there was so much fog. The gas was one or two meters high, all over the place."[51]

Human Rights Watch has reviewed dozens of photos and videos of the crater at Impact Site 1 posted online and provided directly to Human Rights Watch by people who took them. Syria Civil Defense in Idlib posted online some of the first photos of the crater shortly after noon on April 4.[52] Human Rights Watch reviewed the original photos and interviewed the photographer. Based on landmarks visible in the photos and videos, Bellingcat geolocated the crater, showing that it was located near the central bakery in northern Khan Sheikhoun.[53] Satellite imagery confirms that a crater appeared in that location between February 21, the date of the most recent available reference image, and April 6, the first available satellite image after the attack. A reverse image search shows that none of the photos were posted online before April 4.

These photos and videos show that the crater contained two objects that are likely remnants of the weapon that was used: a twisted thin metal fragment with green paint and a smaller circular metal object. The first photos, taken a few hours after the attack, show the twisted metal remnant sticking up from the crater, but most of the crater is not visible

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[50] "OPCW Director-General shares incontrovertible laboratory results concluding exposure to sarin," OPCW news release, April 19, 2017, https://www.opcw.org/news/article/opcw-director-general-shares-incontrovertible-laboratory-results-concluding-exposure-to-sarin//.

[51] Human Rights Watch telephone interview with Adham al-Hussein, April 7, 2017.

[52] Publication on the official Facebook of the Syria Civil Defense in Idlib, April 4, 2017, https://www.facebook.com/SyrianCivilDefenceIdlibWhiteHelmets/photos/a.470699469695781.1073741826.469192429846485/1258287567603630/?type=3&theater.

[53] "The Khan Sheikhoun Chemical Attack, the Evidence So Far," Bellingcat, April 5, 2017, https://www.bellingcat.com/news/mena/2017/04/05/khan-sheikhoun-chemical-attack-evidence-far/.

because the photo is taken from a distance. A second set of photos, taken closer to the crater in the early afternoon, show more of the crater, including the circular object.

The Soviet Union produced several types of chemical bombs for warplanes. According to open source materials, two Soviet-produced bombs were specifically designed to deploy sarin: the KhAB-250, which can contain 44.1 kilograms of sarin, and the KhAB-500, which can contain 177.1 kilograms of sarin. The KhAB-250 bomb also has a filler hole in its body through which the sarin is loaded into the bomb prior to use. Open-source reference materials on Syria's arsenal do not list Soviet-produced chemical bombs, but they are often not complete.

Photos of a Soviet-produced air-dropped sarin bomb exhibited at the Central Armed Forces Museum of the Russian Federation show a bomb with two green-colored bands.[54] Soviet weapons have green-colored bands painted on the munition to signify a chemical weapons. These green bands appear consistent with the green paint on the remnant in the crater at Impact Site 1, seen in photographs provided to Human Rights Watch. The circular object in these photos appears similar to the cap for the filler hole on the body of a photo of the bomb in the museum.[55]

[54] Central Armed Forces Museum of the Russian Federation, virtual excursion, hall 22, http://www.cmaf.ru/ekspo/virtual/. See also community discussion page on VKontakte, https://vk.com/wall-60512759_5917.

[55] The similarities between the remnants in the crater and the photo of a bomb in the museum were first identified by the twitter accounts @elemcee69 and @Mortis_Banned. See e.g., tweet from @elemcee69 on April 14, 2017, https://twitter.com/elemcee69/status/852809433570615296.


In a chemical bomb, an explosive charge busts open the body of the bomb and disperses the chemical as an aerosol cloud, either upon impact or in the air. The ideal explosive charge would be large enough to disperse most of the chemical, but not so large that the heat from the explosion would degrade the chemical. A small explosive charge means that significant remnants of a chemical bomb, including the tail fin, should survive and be found near the impact site. While Human Rights Watch has not seen photos or videos of larger pieces of remnants from the Khan Sheikhoun attack, photos of the two remnants in the crater at Impact Site 1 appear to be consistent with the characteristics of the .

The first photos taken of the crater at Impact Site 1 a few hours after the attack also appear to show liquid on the asphalt around the crater. Several witnesses described it as a black, oily substance. Such liquid is consistent with the use of a sarin bomb, as some of the sarin, which is a liquid, will fail to turn into aerosol and vapor.[56]

[56] Dan Kaszeta, "Anatomy of a sarin bomb explosion (Part I)," Bellingcat, April 13, 2017, https://www.bellingcat.com/resources/articles/2017/04/13/anatomy-sarin-bomb-explosion-part/.

Based on photos and videos, Forensic Architecture, an organization specializing in spatial analysis, created a three-dimensional model of the crater. Based on the model, the organization calculated that the crater was about 1.60 meters wide and 0.42 meters deep. Since there is no public information about how much explosive is contained in the bursting charge for known sarin bombs, it is not possible to assess whether the size of the crater is consistent with the use of these bombs. The lack of blast and fragmentation damage on nearby objects as shown in the photos and videos is consistent with the use of a low-blast, non-fragmenting munition like a chemical bomb.

Chemical exposure from the attack killed at least 89 people, including 33 children and 19 women, and injured 541, according to the opposition-run Idlib Health Directorate, which published a list of the names.[57] Human Rights Watch confirmed 34 of them through interviews with local residents and family members of the dead. A few people appear to have died from blast and fragmentation injuries from the attacks during the second fly-over. Raslan, the Syria Civil Defense member, said that the attacks with explosive weapons killed his neighbor, the neighbor's son, and the 15-year-old boy he had tried to help.[58]

Two Syrian organizations compiled a list of 103 people who had died, but it is not clear from the report whether all died from chemical exposure.[59] Local residents, first responders, and medical personnel confirmed that the vast majority of casualties in the morning attacks were killed and injured by chemical exposure.

Many of the dead belonged to the same families. Members of the al-Youssef family said 25 of their family members who lived in houses near Impact Site 1 died due to chemical exposure.[60] Local residents also said that the victims were civilians, and that armed groups did not have any bases in the town, but Human Rights Watch cannot exclude the possibility that some of the victims were members of armed groups.

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[57] Publication on the official Facebook of the Idlib Health Directorate, April 8, 2017, https://www.facebook.com/Idleb.Health.Directorate/photos/a.648305141939511.1073741828.648124961957529/968373753265980/?type=3 (accessed April 17, 2017).

[58] Human Rights Watch telephone interview with Ismail Raslan, April 21, 2017.

[59] "A Special Report on the Chemical Attack in Khan Sheikhoun – Idlib on April 4, 2017," Syrians for Truth and Justice, April 22, 2017, https://www.stj-sy.com/en/view/123.

[60] Human Rights Watch telephone interview with Abdelaziz al-Youssef, April 6, 2017.

Two theories have been presented to provide an alternative explanation to the allegation that a Syrian government warplane dropped a chemical bomb in Khan Sheikhoun: that an explosive bomb hit a chemical weapons production facility or depot in a warehouse; or that armed groups detonated a chemical weapon on the ground. Human Rights Watch has not found any evidence to support either theory.

Both Russian and Syrian officials have claimed that the chemical exposure occurred because a Syrian airstrike hit an armed group's weapons depot that contained chemical bombs. On April 7, Syria's foreign minister, Walid Muallem, said that Syrian forces had not used chemical weapons and that a Syrian airstrike around 11:30 a.m. on April 4 had hit an ammunition depot belonging to an armed group, causing the chemical exposure.[61] A Russian military official gave a similar account, saying that the airstrike took place between 11:30 a.m. and 12:30 p.m.[62] But there is overwhelming evidence to show that local residents started exhibiting signs and symptoms of chemical exposure several hours earlier, which means that the 11:30 a.m. attacks that Syrian and Russian officials cited cannot explain the chemical exposure.

Human Rights Watch also investigated whether the strikes at Impact Sites 2 and 3 could have dispersed the chemical. Local residents who visited the impact sites said that there were no signs that any chemicals had been stored near the sites. Mohammad Saloum, a local journalist who examined Impact Site 2, the house that was struck closest to Impact Site 1, said: "There were three rooms containing pillows and carpets for sleep. There was nothing else inside. It looked like any other house."[63]

Satellite imagery shows damage to a warehouse and a grain silo near the bakery, but local residents said they were struck before April 4. Photographs of the warehouse that were taken after the April 4 attack show that large sections of the walls are open, allowing people to see inside. Local residents said that the warehouse had been empty and out of use for months except as a volleyball court. A journalist for the *Guardian* who visited the warehouse said

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[61] "Walid Muallem exposes the secrets of the Khan Sheikhoun chemical 'attack'" (وليد المعلم يفضح أسرار "هجوم" خان شيخون الكيماوي), al-Alam, April 6, 2017, http://www.alalam.ir/news/1948704 (accessed April 17, 2017).

[62] Statement on the Khan Sheikhoun attack posted on the official Facebook of the Russian Ministry of Defense, April 4, 2017, https://www.facebook.com/1492252324350852/videos/1903420036567410/ (accessed April 17, 2017).

[63] Human Rights Watch telephone interview with Mohammad Saloum, April 6, 2017.

that he found a volleyball net there, which he filmed.[64] Local residents said that they did not know about any chemicals being stored anywhere in the neighborhood.

## Al-Lataminah, March 30

On March 30, 2017, a warplane attacked the outskirts of al-Lataminah, according to four witnesses. Information from the four witnesses, including medical personnel, and photos and videos of the injured indicate that a nerve agent was used in the attack. The Syrian American Medical Society said that its affiliated hospitals in the area treated 169 people for injuries due to chemical exposure, but that there were no fatalities.[65] One of the witnesses said that the majority of those injured were members of armed groups, but that civilians in the area were injured as well.

The local residents said that aircraft from the Syrian-Russian coalition had carried out multiple aerial attacks in the area, including near al-Lataminah.

Anwar Rahmoun, a farmer who lives on the outskirts of al-Lataminah, told Human Rights Watch that people in his area were on their way to work sometime after 6 a.m. when the attack happened. A warplane dropped two bombs that landed about 100 meters away. The first was not very loud, but the second shook the whole area.

He said he saw a neighbor's 15-year-old son collapse when he went outside. As Rahmoun ran to the car, he saw another relative collapse. Rahmoun soon started feeling the symptoms as well:

> It felt like I was being drugged. I was running, my legs were touching the ground, but I could no longer feel them. Eventually I collapsed and lost consciousness. My brother-in-law said that they had to remove a lot of foam from all over my face when they found me. They took me to a hospital, thinking I was dead, but thankfully I regained consciousness seven hours later.[66]

[64] Human Rights Watch telephone interview with Kareem Shaheen, April 7, 2017.
[65] Human Rights Watch telephone interview with Dr. Mahmoud al-Mohamad. April 8, 2017.
[66] Human Rights Watch telephone interview with Anwar Rahmoun, April 11, 2017.

Abd al-Munaf Faraj al-Saleh, a first responder working for Syria Civil Defense, said that they were watching warplanes flying above al-Lataminah when the attack took place about 700 meters away at about 6:30 a.m. on March 30. He rushed to the scene:

> When we got there, people were suffocating, some critically. They were trembling, had extreme difficulty breathing, redness in their eyes; some had foam coming out of their mouth. People were going unconscious. Some of them started hallucinating, saying weird things, when they got to the hospital. The chemicals in the missiles had a very mild smell but a strong effect.[67]

He said that he had not seen helicopters in the air at the time of the attack. He also said that they could only find very small pieces of the munition on the ground. He did not take photos of the remnants.

Dr. Mahmoud al-Mohamad, a doctor at al-Lataminah hospital, said that the hospital started receiving people injured in the attack in the morning on March 30. The symptoms were different from those they had observed from previous attacks with chlorine:

> At first, we didn't know what it was. There was no chlorine smell. The injured had pinpoint pupils, extreme foaming from the mouth, in an unsteady condition, with muscle cramps, shivers and shaking. Most of them were unconscious. Some people's hearts had slowed down to the point where we thought they were dead.[68]

[67] Human Rights Watch telephone interview with Abd al-Munaf Faraj al-Saleh, April 8, 2017.

[68] Human Rights Watch telephone interview with Dr. Mahmoud al-Mohamad. April 8, 2017.

Severely constricted ("pinpoint") pupil of a man injured in attack near al-Lataminah on March 30 according to the Syrian American Medical Society. © 2017 SAMS

The Syrian American Medical Society (SAMS) provided a photo that it said was of one of those injured in the March 30 attack on al-Lataminah. The photo shows that the man has severely constricted ("pinpoint") pupils.

SAMS, which runs two hospitals in the area and supports two others, said that their hospitals had treated 169 people injured due to chemical exposure in the attack, including seven medical staff and two ambulance workers who suffered from secondary exposure. The group said that nobody had died in their hospitals, but that four people had been placed in the intensive care unit.[69] On April 11, Rahmoun said that his neighbor's son was

[69] Human Rights Watch email correspondence with Mohamad Katoub, advocacy manager, Syrian American Medical Society, April 9, 2017.

still unconscious and connected to a breathing machine. The doctor said that both civilians and combatants were among the injured, and that one was a woman.

Human Rights Watch interviewed the four local residents from al-Lataminah by phone between April 8 and 11, after the Khan Sheikhoun attack. However, local residents and medical personnel described clinical signs and symptoms consistent with exposure to a nerve agent in media interviews and statements before the Khan Sheikhoun attack on April 4. The opposition-run Hama Health Directorate issued a statement about the attack on March 31, noting that the injured had symptoms such as pinpoint pupils, suffocation and nausea, muscle cramps, and loss of consciousness.[70] Medical personnel and victims made similar claims in filmed interviews posted on YouTube. In a video published by the opposition-run Idlib Health Directorate on April 1, two injured people say that they started experiencing the symptoms after a warplane attacked their area.[71]

## Villages in Uqayribat Subdistrict, December 11-12, 2016

In several posts on its Facebook page on December 11 and 12, 2016, the Syrian Revolution Coordination Committee (SRCC) in Eastern Hama reported that warplanes had carried out chemical attacks in five villages in the Uqayribat subdistrict in eastern Hama, about 40 kilometers east of Salamiyah.[72] Human Rights Watch interviewed four witnesses of attacks on two of the villages, Jrouh and al-Salaliyah. The witnesses said that warplanes had attacked the villages, described clinical signs and symptoms consistent with exposure to toxic chemicals, and identified the names of 67 local residents who died from chemical exposure after the attacks. Human Rights Watch also communicated indirectly with two medical personnel via messages sent to intermediaries, a local activist and a medical charity worker, who provided similar accounts.

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[70] Publication on the official Facebook of the Hama Health Directorate, March 31, 2017, https://www.facebook.com/latamenh.h2/photos/a.655052357992256.1073741828.654197224744436/780609392103218/?type=3&theater (accessed April 17, 2017).

[71] "An English version of the report on the chemical attack on Lataminah on Thursday 30 March," April 1, 2017, video clip, YouTube, https://www.youtube.com/watch?v=huhn-4Zbe1c (accessed April 17, 2017).

[72] In the first post, SRCC reported that warplanes had attacked the villages with chlorine. Subsequent posts refer to chemical attacks with Sarin. Publication on the official Facebook of the Syrian Revolution Coordination Committee in Eastern Hama, December 11, 2016, https://www.facebook.com/hama.east/posts/1178624038886863 (accessed April 17, 2017); December 11, 2016, https://www.facebook.com/hama.east/posts/1178805135535420 (accessed April 17, 2017); December 12, 2016, https://www.facebook.com/hama.east/posts/1179416542140946 (accessed April 17, 2017).

Uqayribat is a subdistrict in eastern Hama with about 21,000 people. About 2,500 people live in Jrouh, and 250 in al-Salaliyah, which is about five kilometers from Jrouh. The Dawood Brigade, which controls the area, declared its allegiance to ISIS in December 2013.

The attacks in Uqayribat took place in the context of an ISIS military offensive in the region. On December 8, ISIS launched an attack on government forces in Huwaysis, a village about 30 kilometers southeast of Uqayribat, from the direction of Uqayribat.[73] After heavy fighting, ISIS took control of Palmyra city about 60 kilometers further south on December 11. The battle then moved to the Tiyas airbase, about 50 kilometers west of Palmyra. Syrian pro-government media had previously reported that Russian and Syrian warplanes had been targeting ISIS along the highway from Uqayribat to Palmyra.[74]

Because ISIS controls the area and monitors communication, it has been difficult to reach witnesses. The witnesses Human Rights Watch interviewed said that it had not been possible to take photos. One local resident said: "We didn't take any photos. If you take photos, ISIS will kill you."[75] Human Rights Watch interviewed three of the witnesses after they left ISIS-controlled territory, and communicated indirectly with the two medical personnel in December and January, before the Khan Sheikhoun attack.

The witnesses believed that Russian or Syrian warplanes carried out the attacks because there had been aerial attacks in the area in the days before and after the attack, including attacks using cluster munitions and barrel bombs, weapons that only the Syrian-Russian coalition have used in Syria. All attacks listed in the December 11 and 12 daily reports from the US-led international coalition fighting ISIS were far from Uqayribat.

The three residents and two medical personnel from Jrouh said that a munition struck the street near the roundabout in the village around 7 a.m. in the morning on December 12.

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73 Leith Fadel, "ISIS suffers heavy casualties in failed offensive north of Palmyra," al Masdar News, December 8, 2016, https://www.almasdarnews.com/article/isis-suffers-heavy-casualties-failed-offensive-north-palmyra/.

74 Leith Fadel, "Russian, Syria air forces hunt ISIS terrorists along Hama-Palmyra Highway," al Masdar News, June 6, 2016, https://www.almasdarnews.com/article/syrian-air-force-hunts-isis-terrorists-along-hama-palmyra-highway/.

75 Human Rights Watch telephone interview with "Salim" (not his real name), April 9, 2017.

"Salim," a Jrouh resident, said that he went to nearby olive groves that morning when he heard the sound of a warplane because he was afraid of hiding in the underground shelter in his home. From the olive groves, he said he saw the plane attacking the village. When he went back to his house 30 minutes later, after the plane left, he found that a munition had hit the roundabout in front of his house. He said he found his wife, three children, brother, brother's wife, and brother's three children dead in the basement of their house, where they had sought shelter.[76]

"Salim" said that the attack also killed his neighbors, his uncle, and the families of his uncle's two sons. "Everyone within 100 meters died," he said. "There was no one else left." "Salim" buried his family in the village and left the same day.

"Khaled," also from Jrouh, gave a similar account. He said he was at home around 7:30 a.m. on December 12 when he heard somebody shouting that his family had died. He ran out and followed the man to a house about 80 meters northeast of the roundabout. He said that they found 70-year-old Abd al-Razak al-Hussein, his wife, and their two sons unconscious in the house. They took the four to the hospital. "Khaled" said that al-Hussein and his wife died, while their two sons survived. He then ran to a home about 25 meters south of the roundabout, where the al-Mhawesh and al-Hassan families had sought shelter in the basement. They all were dead.[77]

A SRCC member provided Human Rights Watch with the names of 25 people, including 9 children, who died in Jrouh due to chemical exposure. "Salim" and "Khaled" confirmed many of the names. A relative who was not in the area at the time of the attacks provided photos and names of 15 people killed in the attack.[78] SRCC posted photos of at least eight young children, apparently lifeless, some of whom had foam around their noses, saying that they had died in the attack.[79]

Human Rights Watch also interviewed "Abu Ali," who said he witnessed a similar attack with two munitions in al-Salaliyah, one kilometer from al-Khdera, where he lived, at approximately 7:30 a.m. on December 12. The explosion from the first munition was loud

[76] Human Rights Watch telephone interview with "Salim," April 9, 2017.

[77] Human Rights Watch telephone interview with "Khaled" (not his real name), December 22, 2016.

[78] Photos on file with Human Rights Watch.

[79] Photos on file with Human Rights Watch.

and created black smoke, while the explosion from the second, about 10 minutes later, was more subdued. He said he drove to the second impact site, which was near caves where people from the village had sought shelter from the attacks: "I entered one of the caves. There were about 20 people in it. A lot of them were unconscious, some vomited, and they were weak. Most of them were women and children. Some of the injured completely lost their sight after the attack."[80]

"Abu Ali" said that the attack killed 42 people in al-Salaliyah due to chemical exposure. Most of the people who died had been hiding in two caves. A woman from the village provided Human Rights Watch with a list of 41 people who died in the attack. Human Rights Watch has not been able to independently verify the names or the death toll.

A local activist passed on questions from Human Rights Watch to a medic in Jrouh in December who corroborated "Abu Ali's" account about the attack in al-Salaliyah, saying that the hospital in Jrouh, which had been treating victims from the Jrouh attack, eventually also received injured from al-Salaliyah: "At first, nobody knew about this attack. We were too busy treating the injured in Jrouh. And almost all the remaining people in the village had been poisoned. A few hours later we started receiving injured people from there as well."

The six witnesses in both Jrouh and al-Salaliyah described similar clinical signs and symptoms that they observed in people near the impact sites. The medic in Jrouh said that he arrived at the impact site five minutes after the attack. Several people were in the street, exhibiting symptoms including convulsions, shortness of breath, hysteria, red eyes, swollen faces, and foaming and bleeding from the mouth.

Four of the witnesses said that they experienced symptoms as well. "Khaled" described how he felt by the time he got to al-Hassan's house in Jrouh:

> When I arrived at the door, I could not stand, I could not breathe, and I could not see anything. Somebody helped me walk away because I couldn't walk on my own. I began to vomit. My body was hot and cold at the same

[80] Human Rights Watch telephone interview with "Abu Ali" (not his real name), April 11, 2017.

> time. Somebody took me to the hospital where I stayed for five days, vomiting all the time.[81]

"Salim" also described his symptoms: "My eyes were swollen. My chest hurt, and I was coughing. My head hurt, and I became dizzy. I threw up. The doctor said my pupils got big – they filled the whole eye."[82] Abu Ali said: "Afterward, I started vomiting and my head started hurting as well. Almost everybody who helped transport the injured got sick."[83]

Four of the witnesses said that they or the people they saw experienced dilated pupils. While dilated pupils are not a common symptom of exposure to a nerve agent, it can be seen occasionally, depending upon the degree and route of exposure. One doctor said that the injured exhibited constricted pupils, a symptom of exposure from a nerve agent.

The witnesses differed in their description of the odor at the sites and whether there was any visible smoke. Some said that they saw yellow or white smoke, but others did not. Some also said that there was a strong odor, although they could not describe it, while others said that they could not detect any. All said that they saw dead animals such as cattle and cats after the attack.

Human Rights Watch has not seen any photos of remnants used in the attacks.

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[81] Human Rights Watch telephone interview with "Khaled," December 22, 2016.

[82] Human Rights Watch telephone interview with "Salim," April 9, 2017.

[83] Human Rights Watch telephone interview with "Abu Ali," April 11, 2017.

# IV. Ground-Launched Munitions

Since at least January 30, 2017, photos and videos of weapon remnants and information from witnesses show that government forces have used improvised ground-launched rockets filled with chlorine on territory near Damascus controlled by armed groups fighting the government on at least six occasions in four different areas. While several of the attacks injured members of armed groups near the frontlines, witnesses said that all of the injured in at least two attacks – 79 people in total – were civilians.

These attacks took place in the context of the government's renewed offensive to wrest control from armed groups. In Wadi Barada, northwest of Damascus, a January 8 attack took place after government forces launched a military offensive on December 23. In eastern Ghouta and the adjacent eastern part of Damascus, multiple attacks took place before and after government forces launched a military offensive on February 18.[84] Eastern Ghouta, together with western Ghouta, was the site of the 2013 chemical attack that led to Syria joining the Chemical Weapons Convention and destroying its declared chemical weapons stockpile and program.

For the six attacks listed below, Human Rights Watch interviewed witnesses who described a distinctive odor and the clinical signs and symptoms consistent with use of chlorine, and said that government ground forces had fired the chlorine munitions. For two of these attacks, Human Rights Watch reviewed photos and videos of remnants of the weapons allegedly used in the attacks that were posted online and provided by local residents. Videos and photos from a seventh attack show similar remnants, but Human Rights Watch was not able to interview witnesses to this attack.[85]

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[84] "Syrian government forces press attack on Damascus outskirts – monitors, medic," *Reuters*, February 19, 2017, http://uk.reuters.com/article/uk-mideast-crisis-syria-idUKKBN15Y08C?il=0 (accessed April 14, 2017).

[85] On February 21, the armed group Jaysh al-Islam posted a filmed interview with one of its members on their website, saying that eight munitions with chlorine had struck the group in the area between Hawsh al-Dawahira and Hawsh Nasri. "Assad targets al-Ghouta with chlorine gas again" (الأسد يستهدف الغوطة بغاز الكلور مجدداً), jaishalislam.org, February 21, 2017, https://www.jaishalislam.org/subject/487 (accessed April 14, 2017). On February 24, journalists embedded with the group published photos of the same remnants. Tweet from the Twitter account of journalists and photographers embedded with Jaysh al-Islam, February 24, 2017, https://twitter.com/Azm_Lens/status/835057867770191872 (accessed April 14, 2017).

The photos and videos of the remnants show deformed gas cylinders and rocket remnants, indicating a type of weapon sometimes referred to as a lob bomb or improvised rocket assisted munition (IRAM). An IRAM is an improvised device made from a large metal canister, often a propane gas tank, placed on top of a rocket. In Iraq, where the device has been used since 2007, insurgents filled the canister with explosives, scrap metal, and ball bearings.[86] Because they are pressurized gas canisters, they can also contain chemical products.

Analyzing photos of remnants from a January 30 attack in Marj al-Sultan posted online, Bellingcat identified them as Iranian-made 107mm rockets, typically launched from a Type-63 multiple rocket launcher, a system that both government forces and armed groups fighting the government have used in Syria.[87] The design of the weapon indicates that it has a relatively short range and is highly inaccurate. The relatively short range is consistent with the fact that most attacks near Damascus have taken place close to frontlines.

The IRAMs recently reported as used in eastern Ghouta are similar to weapons used in the 2013 sarin attack on Ghouta, but smaller.

## Qaboun, March 29 and April 7

On March 29 and April 7, 2017, ground-launched improvised rockets with chlorine struck the Qaboun neighborhood in eastern Damascus, injuring dozens, according to a doctor, a first responder, and a local journalist, as well as photos of weapon remnants they shared with Human Rights Watch.

Obeida Abu Omar, a member of the Syria Civil Defense, said that he was on his way to the civil defense center around 5 p.m. on March 29 when he heard that there had been a chlorine attack in Qaboun. He was there five minutes later and said: “When I arrived, I could smell the gas. The chlorine smell was clear, very clear. It was all over.”

[86] “Improvised rocket-assisted munitions (IRAM),” Joint Improvised Explosive Device Defeat Organization (JIEDDO), https://www.jieddo.mil/content/docs/JIEDDO_IED_Tri-fold_v3sm.pdf.

[87] Hady al-Khatib, “New Visual Evidence about Chlorine Gas Attacks in Eastern Ghouta,” Bellingcat, February 14, 2017, https://www.bellingcat.com/news/mena/2017/02/14/new-visual-evidence-chlorine-gas-attacks-eastern-ghouta/ (accessed April 14, 2017).

Abu Omar and his team found several injured people in the area, whom they helped to the hospital. He described their symptoms:

> They included suffocation, difficulty breathing, extreme coughing, and liquid dripping from the nose. No one was unconscious but they were dizzy. The last one I found was fifteen minutes later. At that point, I started getting sick myself: suffocation, difficulty breathing, and dizziness.[88]

Dr. Nizar al-Madani, who works in a hospital in Qaboun, said that the hospital received about 35 injured people around 5 p.m. on March 29 who suffered from chemical exposure. He said that the attack took place not far from the hospital. "The odor even reached the hospital. There was a clear odor from the injured people's clothes. It smelled like chlorine. We know it well. When it's concentrated, it causes suffocation. They use it in cleaning products and in pools."[89]

Both Abu Omar and Dr. al-Madani said that the area attacked on March 29 was residential and those injured were civilians; Abu Omar said there were no armed groups present in the area.

Both Abu Omar and Dr. al-Madani said that another attack happened on April 7 around 2 p.m. on the border between the Qaboun and Tishreen neighborhoods. Both said that the area hit had been largely destroyed in previous attacks and that few people still lived there. Dr. al-Madani said that the hospital received two people injured in the attack. The two injured told Dr. al-Madani that they were seeking shelter in a basement when gas started seeping in and they started suffocating. By the time they got to the hospital there was a clear chlorine odor coming from their clothes.[90] Dr. al-Madani and Abu Omar said that they did not know whether the injured were civilians or combatants. A video posted on YouTube claims to show the two men receiving treatment.[91] Abu Omar said there was no

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[88] Human Rights Watch telephone interview with Obeida Abu Omar, member of the Syria Civil Defense, April 11, 2017.

[89] Human Rights Watch telephone interview with Dr. Nizar al-Madani, April 9, 2017.

[90] Ibid.

[91] "Cases of suffocation after Chlorine gas was dropped on al-Qaboun neighborhood of Damascus" ("حالات اختناق نتيجة القصف بغاز "الكلور على حي القابون بدمشق 7-4-2017"), April 7, 2017, video clip, YouTube, https://www.youtube.com/watch?v=_vEYAoSs-BA (accessed April 14, 2017).

indication that the two people injured on April 7 were fighters, but he is not sure that they were civilians.A local journalist went to the site of the April 7 attack the following day. “Even the day after the attack, the odor made me dizzy,” he said.[92]

Dr. al-Madani described the clinical signs and symptoms of the patients: “In both instances, there were clear respiratory symptoms: extreme coughing, difficulty breathing, drooling from the nose, tearing in the eyes, and headaches. At some points, the lack of oxygen would cause shaking.”[93]

Abu Omar said that he did not see or hear aircraft flying in the air at the time of the March 29 attack.[94] He shared with Human Rights Watch photographs of remnants of the munition that he found at the impact site.[95] The photos show a gas cylinder deformed by impact, which is consistent with other chemical IRAM remnants. Human Rights Watch was not able to verify what munition was used on April 7.

Deformed gas cylinder that a Syria Civil Defense member said was found at the site of a March 29 attack in the Qaboun neighborhood in eastern Damascus, which is controlled by armed groups fighting the government.
© 2017 Obeida Abu Omar

## Irbin, February 9 and 10

On February 9 and 10, 2017, at least six members of an armed group were injured from exposure to chlorine, according to a

[92] Human Rights Watch telephone interview with journalist (name withheld), April 13, 2017.

[93] Human Rights Watch telephone interview with Dr. Nizar al-Madani, April 9, 2017.

[94] Human Rights Watch telephone interview with Obeida Abu Omar, April 11, 2017.

[95] Photos on file with Human Rights Watch.

hospital employee. In a filmed interview, a member of the armed group gave a similar account.

An employee at Irbin hospital said the hospital received three injured people around 7 a.m. on February 9: "They were unable to breathe, suffocating, and shaking uncontrollably. All they wanted was to get air. It was like their eyes were about to pop out. One of them was in critical condition and did not regain consciousness until the evening."[96] The hospital employee said that another man had apparently fallen into a fire when the attack happened and arrived at the hospital with severe burns and later died from the wounds. The hospital employee said that the hospital received three more injured people around 4:30 p.m. on February 10 with similar, but milder injuries.

Several videos posted on YouTube claim to show two or three people receiving oxygen in the Irbin hospital following the attack.[97] In a video posted on YouTube on February 10, a fighter from the Faylaq al-Rahman Brigade says that an attack with poisonous gas injured three and killed one, but does not specify whether it was ground-launched or dropped from the air. The title of the video indicates that the injured and killed were fighters.[98]

The hospital employee said that the injured told him that the attacks took place near the Ghubair mosque, near the frontlines, and that the munitions were ground-launched. He said that the injured in both cases were members of an armed group.[99]

Human Rights Watch has not been able to locate photos or videos of the remnants from these attacks.

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[96] Human Rights Watch telephone interview with hospital employee (name withheld), March 10, 2017.

[97] "Several injuries caused by chlorine gas…" (العديد من الإصابات جراء استهداف اطراف عربين بغاز الكلورمن قبل تنظيم الأسد), February 9, 2017, video clip, YouTube, https://www.youtube.com/watch?v=iUMDOKP4yQY&feature=youtu.be; "Irbin hospital…" (مشفى عربين الجراحي استهداف اطراف المدينة بغاز الكلور), February 9, 2017, video clip, YouTube, https://www.youtube.com/watch?v=Mdt-QyUyQ2s&feature=youtu.be.

[98] "Deaths and injuries from poisonous gas attack on Irbin" (قتيل وإصابات من الفصائل جراء قصف بغاز سام للنظام على عربين ريف دمشق) https://www.youtube.com/watch?v=rdMMi7VLLDo&feature=youtu.be (accessed April 14, 2017).

[99] Human Rights Watch telephone interview with hospital employee (name withheld), March 10, 2017.

## Marj al-Sultan, January 30

A member of the al-Marj media office told Human Rights Watch that 12 rockets containing chlorine gas hit al-Neshabiyeh village around 2 p.m. January 30, injuring eleven, two of them critically. He said local residents had given him the information when he visited the site after the attack.[100]

He said he saw two rockets, one that had been excavated and one that was still buried in the ground. The rockets had hit farming land within the village. He said he could still smell the chlorine when he visited.[101]

The al-Marj media office posted a video on YouTube of a man showing weapon remnants, explaining four rockets hit an area with civilians, injuring ten. Seven or eight rockets hit the frontline.[102] The media office also posted three photos of the same weapon remnants on its Facebook page.

The Unified Medical Office of Eastern Ghouta published a statement on January 31 saying that the hospital in al-Marj treated eleven people injured by chemical exposure, three of whom were in critical condition. It said symptoms included extreme difficulty breathing, foaming at the mouth, and pinpoint pupils.[103]

## Basimah village, Wadi Barada, January 8 and 9

Three local residents, including a nurse, said dozens of civilians in Basimah village in the Wadi Barada valley were injured from exposure to chlorine after three attacks on January 8 and 9, 2017.

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[100] Human Rights Watch telephone interview with Abou Mu'tassem, member of the al-Marj media office, April 19, 2017.

[101] Ibid.

[102] "Eastern Ghouta, al-Marj" (الغوطة الشرقية ـ منطقة المرج), January 31, 2017, video clip, YouTube, https://www.youtube.com/watch?v=3HXZjvHxdJE&feature=youtu.be (accessed April 14, 2017).

[103] Publication on the official Facebook of the Unified Medical Office of Eastern Ghouta, January 31, 2017, https://www.facebook.com/Medical.Office.alghota/posts/1026007784209219:0 (accessed April 14, 2017). Pinpoint pupils is not a symptom of chlorine exposure. Human Rights Watch has not been able to clarify the discrepancy between this symptom and reports of chlorine odor.

On December 23, pro-government forces launched a military offensive against territory held by armed groups fighting the government in the Wadi Barada valley.[104] At the time of the attack, pro-government forces were stationed on mountains around the village, according to the three witnesses said. Pro-government forces captured Basimah village on January 13 and established control over the entire valley on January 30.[105]

The three witnesses gave different accounts as to when the attacks happened on January 8 and 9. One said that the first attack happened in the morning on January 8, another said it happened in the afternoon. However, all three witnesses said that they smelled chlorine and described clinical signs and symptoms consistent with exposure to chlorine gas. Ali Nasrallah, who was the head of the media council in Wadi Barada, said that the first attack on January 8 struck the Hasra neighborhood, a residential area with no fighters:

> I went out as soon as I heard the explosion. People were shouting: Careful, it is chlorine gas! I ran to the underground shelter. There were between 10 and 15 civilians there with breathing problems. We wanted to take the injured to a higher place, but we couldn't. The people were really, really scared.[106]

Nasrallah said that there was a strong odor of chlorine in the area and that he saw yellow smoke in the area.[107]

A nurse at the Basimah medical point, also named Ali Nasrallah, told Human Rights Watch that he could smell chlorine on the injured people's clothes. He said the injured suffered from suffocation, irritation of the eyes, nausea, and vomiting. Nasrallah said the medical staff treated 46 people who were injured in the attacks due to chemical exposure.[108]

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[104] "Damascus water supply cut after rebels pollute it: authority," Reuters, December 23, 2017, http://www.reuters.com/article/us-mideast-crisis-syria-water-idUSKBN14C20Q?il=0.

[105] Leith Fadel, "Syrian Army reaches gates of Wadi Barada springs," al Masdar News, January 13, 2017, https://www.almasdarnews.com/article/syrian-army-reaches-gates-wadi-barada-springs/ (accessed April 17, 2017).

[106] Human Rights Watch telephone interview with Ali Nasrallah, media activist, April 13, 2017.

[107] Ibid.

[108] Human Rights Watch telephone interview with Ali Nasrallah, nurse, April 18, 2017.

# V. Acknowledgments

This report was written by Ole Solvang, deputy director of the Emergencies Division at Human Rights Watch and researched by Lama Fakih, deputy director of the Middle East and North Africa Division, Charbel Salloum, research assistant of the Middle East and North Africa Division, Solvang, and Priyanka Motaparthy, senior researcher of the Emergencies Division. Interns in the Middle East and North Africa Division and the Emergencies Division provided support. The report was edited by Sarah Leah Whitson, director of the Middle East and North Africa Division. Clive Baldwin and Iain Levine provided legal and program reviews. Mark Hiznay from the Arms Division provided specialist review.

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# Appendix I: Sarin

Sarin is an organophosphorus compound, part of a family of chemicals that include other chemical warfare agents such Tabun, Soman, and VX, as well as various pesticides and insecticides. In its pure form, sarin is a colorless and odorless liquid. It can evaporate, forming a gas that is toxic when even low concentrations are inhaled. Munitions are often designed to distribute the nerve agent as an aerosol, consisting of fine droplets of the liquid. When inhaled or deposited onto the skin, these droplets are extremely toxic. The aerosol is heavier than air, and eventually tends to collect in lower lying areas around the site of impact.

Sarin binds to and inhibits acetylcholinesterase, an enzyme that catalyzes the breakdown of acetylcholine, which is a biochemical messenger that activates muscles. Sarin exposure therefore leads to the over-stimulation of muscles and glands. Sarin also has a negative influence on the autonomic nervous system, which exerts “involuntary” control throughout the body, including secretion of internal fluids produced to moisten airways leading to the lungs, and on the involuntary muscles that control the gastrointestinal tract.

Symptoms depend both on the level and route of sarin exposure. Low levels can cause increased production of saliva, temporary excessive contraction of the pupils, a runny nose, and a feeling of pressure on the chest. Moderate exposure can cause coughing, excessive fluid discharge from the nose and mouth, difficulty breathing, muscular weakness, and tremors and convulsions. Diarrhea and vomiting are also often observed at these levels of exposure. High exposure can causes convulsions and loss of consciousness, and affects muscles and the part of the nervous system involved in breathing. Sarin exposure can cause death by suffocation due to the excessive buildup of fluids in the breathing airways and to loss of activity of the muscles used for breathing.

Exposure to other nerve agents, including some pesticides, can cause similar symptoms, but much higher levels of exposure are required in these cases.

Poisoning by sarin works faster when the agent is absorbed through the respiratory system, because the multiple blood vessels in the lungs distribute the toxic agent rapidly throughout the body. The injury caused by a sarin weapon therefore depends on the extent

to which the weapon turns liquid sarin, the form in which it is at room temperature, into aerosol, a mist of fine droplets, that can be inhaled or absorbed by the skin. In a sarin bomb, the liquid is converted into an aerosol by a small explosive detonation that bursts the carrier munition and creates an aerosol cloud. If the detonation is too large, however, the heat will damage the sarin, which decomposes rapidly at its boiling point of 158 degrees Celsius. This limitation usually means that not all the sarin liquid contained in a bomb turns into aerosol or vapor, and that liquid sarin is often found at an impact site immediately after an attack.

Sarin is a non-persistent nerve agent, which means that the agent quickly chemically degrades and disperses into the atmosphere. A non-persistent nerve agent dissipates and rapidly loses the ability to cause casualties after 10 to 15 minutes. The area of contamination will depend on many different factors, including the amount and purity of the sarin used, the effectiveness of the chemical munition in dispersing the agent, the outside temperature and humidity, the wind direction and speed, and the presence of buildings in the area, which might shield victims from the effects of the toxic cloud. Nerve agents are so toxic that munitions containing only a small amount of sarin, such as the 49 kilogram chemical payload of a 250-kilogram sarin bomb, can readily disperse millions of lethal doses over an area several hundreds of meters in radius away from the impact site, depending upon the local meteorological conditions.

Many types of chemical bombs are stored empty without the payload because of the limited shelf-life of chemical agents like sarin after it is produced. The precursors for sarin are stored separately and only combined into the final product prior to use; the shelf-life of sarin depends on the specific reaction process used, the addition of other chemicals to stabilize the substance, and the amount of impurity present in the precursor chemicals.

The munitions and filling equipment used for chemical agents must have sealed joints in order prevent leakage and exposure. The integrity of these seals are tested prior to loading live agent into the munition to ensure no leaks occur. Once produced, the agent then needs to be transferred into the munition by a filling system through a filler hole in the bomb body. The crews filling chemical munitions with live agent must take precautions like using protective masks or respirators and wearing impermeable suits and boots.

The physical infrastructure necessary to produce multiple liters of live agent, successfully transfer this agent into a weapon, and effectively deliver the agent to the battlefield as an aerosol, droplet, or vapor form requires knowledge of chemical production and functioning equipment. Also required is a cadre of trained personnel operating equipment in a safe manner without exposing themselves to the effects of the live agent.

UN inspectors concluded that sarin was used in a chemical attack in Ghouta, near Damascus, in August 2013. Evidence documented by Human Rights Watch strongly suggests that government forces were responsible for the attack. In June 2014, OPCW announced that it had shipped Syria's declared chemical weapons out of the country. OPCW has said that it inspected all declared sites, except two, which it could not reach because of safety and security concerns. It said that Syria declared those sites as abandoned and that the chemical weapons program items they contained were moved to other declared sites, which were inspected.

# Appendix II: Air-Dropped Sarin Munitions [Added October 18, 2017]

Little information is publicly known about the origin and extent of Syria's air-dropped chemical munitions in open source materials. Until it was forced to admit to its existence after a major chemical weapons attack in 2013, the Syrian government denied that it even had a chemical weapons program.

Per declassified French and US intelligence assessments, as well as Israeli research reports, many of them published before the breakout of the Syrian conflict in 2011, Syrian authorities possessed air-dropped munitions designed to deliver sarin.[109] It is not clear from these sources, however, whether the stockpile included imported or domestically produced air-dropped sarin bombs. Specific detail on the types of chemical weapons declared by Syria as part of its implementation of the Chemical Weapons Convention is not publicly available.

Declassified US intelligence reports from the 1980s indicate that the Soviet Union supplied Syria with chemical agents, delivery systems, and training related to chemical weapons use.[110] A Russian official involved in chemical weapons destruction denied this in August 2012, saying that neither Russia nor the Soviet Union had supplied Syria with chemical weapons.[111]

Some of the few good reference photos of air-dropped sarin munitions in open source materials are of a Soviet-produced bomb exhibited at the Central Armed Forces Museum in

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[109] "National Evaluation of Declassified Information: Syrian Chemical Weapons Program, Use of Chemical Weapons by the Regime on 21 August 2013" (Synthèse nationale de renseignement déclassifié: Programme chimique syrien, Cas d'emploi passés d'agents chimiques par le régime, Attaque chimique conduite par le régime le 21 août 2013), Government of France, September 2, 2013, http://www.humanitarian.net/idin/ref/syrie_synthese_nationale_de_renseignement_declassifie_02_09_2013.pdf (accessed June 12, 2017). For a compilation of relevant US documents, see "Weapons of Mass Destruction: Intelligence Threat Assessments," Federation of American Scientists, February 7, 2012, https://fas.org/irp/threat/wmd.htm. See reference to *the Middle East Military Balance, 1994-1995*, in M. Zuhair Diab, "Syria's Chemical and Biological Weapons: Assessing Capabilities and Motivations," in *Report: Syria's Chemical and Biological Weapons*, https://www.nonproliferation.org/wp-content/uploads/npr/diab51.pdf, p. 105. See also reference to 1996 Israeli report, Ibid., p. 105.

[110] Mary Beth D. Nikitin, Paul K. Kerr, Andrew Feickert, "Syria's Chemical Weapons: Issues for Congress," Congressional Research Service, September 30, 2013, https://fas.org/sgp/crs/nuke/R42848.pdf.

[111] Ibid.

Moscow.[112] The bomb has "Sarin" written in Cyrillic letters on the front, green painted bands, which is a signifier of chemical weapons, and a distinct filling hole cap located on the side. The shape of the bomb indicates that it belongs to the 250-kilogram class of Soviet bombs. Furthermore, Soviet authorities published in 1987 a document describing several chemical munitions after Western observers visited a military facility in the Soviet Union during a disarmament conference. The munitions included a 250 kilogram air-dropped bomb whose purpose was "to disable personnel through respiratory organs" by deploying 49 kilograms of sarin through the use of an instantaneous action percussion fuze, which would detonate the bomb when it hit the ground.[113] The document included a line-drawing of the bomb, showing a similar shape to the bomb in the museum photos. The filler hole in the drawing, however, appears to be located higher on the bomb than the filler hole on the bomb in the museum.[114]

Neither the museum exhibition nor the 1987 document provide the official name of the air-dropped sarin bomb, although a handwritten label on the bomb in the museum shows the number 9-A-164.[115] In books and articles about the development and disarmament of chemical weapons in the Soviet Union and Russia, Lev Fedorov, a Russian scientist, mentions several names of Soviet-produced air-dropped sarin bombs. He mentions two air-dropped sarin bombs with the name KhAB (the KhAB-100 and KhAB-250), which is an abbreviation for the Russian term *Khimicheskaya Aviatsionnaya Bomba*, or "Chemical Aviation Bomb."[116] The number following the initial letters indicates the size of the bomb in

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[112] Central Armed Forces Museum of the Russian Federation, virtual excursion, hall 22, http://www.cmaf.ru/ekspo/virtual/. See also the discussion page from the Weapons of Mass Destruction group on VKontakta (VK) dated March 18, 2015, https://vk.com/wall-60512759_5917.

[113] Conference on Disarmament, Information on the presentation at the Shikhany military facility of standard chemical munitions and of technology for the destruction of chemical weapons at a mobile unit, CD/789, December 16, 1987, https://disarmament-library.un.org/UNODA/Library.nsf/a61ff5819c4381ee85256bc70068fa14/d775b9d1998f6a6c852575cc0054319a/$FILE/cd-789.pdf (accessed June 12, 2017).

[114] Ibid., p. 32.

[115] In a post on its Facebook page commenting on the initial May 1, 2017, release of Human Rights Watch's report about the Khan Sheikhoun attack, the Russian Ministry of Defense appears to refer to the bomb in the photo as a KhAB-250. Facebook page of the Russian Ministry of Defense, post dated May 2, 2016, https://www.facebook.com/1492252324350852/photos/a.1492313031011448.1073741828.1492252324350852/1918049911771089/?type=3 (accessed June 26, 2017). The Ministry of Defense appears to have subsequently deleted the Russian language post. As of August 28, the English language post could still be found here: https://www.facebook.com/mod.mil.rus/photos/a.1492313031011448.1073741828.1492252324350852/1918049911771089/?type=3&theater.

[116] Lev Fedorov, Chemical Armaments – War with Its Own People (The Tragic Russian Experience), Moscow 2009, http://levfedorov.ru/chemarmament-7-1/ (accessed June 26, 2017), vol. 1, sec. 7. Responding to Human Rights Watch's May 1, 2017 report on the Khan Sheikhoun attack, a Russian military spokesperson claimed that the KhAB-250 had never been designed to deliver sarin. See the Facebook page of the Russian Ministry of Defense, post dated May 2, 2016, https://www.

kilograms. According to Fedorov, a second set of names of air-dropped sarin bombs starts with the letters OKhAB (OKhAB-100, OKhAB-100SP, OKhAB-250, OKhAB-250-135P, OKhAB-250-235P).[117] Human Rights Watch has not been able to confirm what the O designates in this instance. Finally, Fedorov also mentions an air-dropped sarin bomb with the name OBAS-250-235P. Human Rights Watch has not been able to confirm what the abbreviation OBAS stands for. In one place, Fedorov links the OBAS-250-235P to the index number 9-A-164, which is the number written on the bomb in the museum, saying that this is the bomb that was also showcased to diplomats in 1987.[118] In another place, Fedorov says that it was the OKhAB-250 that was showcased in 1987.[119]

In an interview with *Agence France-Presse* following the Khan Sheikhoun attack, Syrian President Bashar al-Assad said that the Syrian government was not responsible for the attack since it no longer possesses chemical weapons.[120] The Organisation for the Prohibition of Chemical Weapons has said that all chemical weapons materials that the Syrian government declared have been removed from Syria, but that it has been unable to verify whether the Syrian declaration was accurate and complete.[121] As of July 2017, the OPCW was still trying to resolve "declaration-related issues."[122] According the Director General of the OPCW, cited in a Reuters article, the organization is still seeking answers

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facebook.com/1492252324350852/photos/ a.1492313031011448.1073741828.1492252324350852/1918049911771089/?type=3 (accessed June 26, 2017). This appears incorrect. For example, the five-year plan adopted at the 20th Communist Party Congress in 1956 included the production of 3,500 KhAB-250-140P sarin bombs at factory 91 in Stalingrad; see Lev Fedorov, Chemical Armaments – War with Its Own People, http://lev fedorov.ru/chemarmament-7-1/, vol. 1, sec. 7. The Ministry of Defense appears to have subsequently deleted the Russian language post. As of August 28, the English language post could still be found here: https://www.facebook.com/mod.mil.rus/photos/a.1492313031011448.1073741828.1492252324350852/1918049911771089/?type=3&theater.

[117] See e.g., Lev Fedorov, Chemical Armaments – War with Its Own People (The Tragic Russian Experience), Moscow 2009, http://levfedorov.ru/chemarmament-10-5/ (accessed June 12, 2017), vol.1, chapter 10.5.

[118] Ibid., table 3.

[119] Ibid., table 4.

[120] "Syria's Bashar al-Assad labels Idlib chemical attack 'fabrication' to justify US strike," *AFP*, April 14, 2017, http://www.abc.net.au/news/2017-04-14/syria-assad-says-idlib-chemical-attack-was-a-fabrication/8444470.

[121] "OPCW-UN Joint Mission Statement on the Complete Removal of Declared Chemical Weapons Materials," UN press release, June 23, 2014, https://opcw.unmissions.org/opcw-un-joint-mission-statement-complete-removal-declared-chemical-weapons-materials. Organization for the Prohibition of Chemical Weapons, Progress in the Elimination of the Syrian Chemical Weapons Programme, S/2016/678, August 3, 2016, http://www.securitycouncilreport.org/atf/cf/ %7B65BFCF9B-6D27-4E9C-8CD3-CF6E4FF96FF9%7D/s_2016_678.pdf, paras. 7-10.

[122] Organization for the Prohibition of Chemical Weapons, Progress in the Elimination of the Syrian Chemical Weapons Programme, EC-86/DG.2, July 24, 2017, https://www.opcw.org/fileadmin/OPCW/EC/86/en/ec86dg02_e_.pdf.

from Syria about undeclared chemical aerial bombs.[123] The same article claims that 2,000 chemical bomb shells, which Syria said it had converted to conventional weapons and either used or destroyed, are unaccounted for.[124] The article does not specify how many, if any, of those munitions are aerial. A defector who says he was a senior officer in Syria's chemical weapons program has said that Syrian authorities had more chemical weapons than they declared.[125]

Syrian government officials, including President Assad, have also denied that Syrian authorities have used chlorine as a weapon, despite extensive documentation to the contrary, including by a UN-OPCW Joint Investigative Mechanism, which concluded that Syrian government helicopters used chlorine on at least three occasions in 2014 and 2015.[126]

[123] Anthony Deutsch, "Special Report: How Syria continued to gas its people as the world looked on," Reuters, August 17, 2017, https://www.reuters.com/article/us-mideast-crisis-syria-chemicalweapons/special-report-how-syria-continued-to-gas-its-people-as-the-world-looked-on-idUSKCN1AX107.

[124] Ibid.

[125] Harry Cockburn, "Assad still has 'hundreds of tonnes' of chemical weapons in stockpile, former Syrian weapons chief claims," Independent, April 14, 2017, http://www.independent.co.uk/news/world/middle-east/bashar-al-assad-chemical-weapons-attack-stockpile-syria-obama-trump-moscow-a7684706.html.

[126] "Syria's Assad denies alleged use of chlorine gas in Idlib," Press TV, April 21, 2015, http://www.presstv.com/Detail/2015/04/21/407269/Syrias-Assad-denies-chlorine-gas-use. Organization for the Prohibition of Chemical Weapons-United Nations Join Investigative Mechanism, Fourth Report, S/2016/888, October 21, 2016, http://undocs.org/S/2016/888.

# Appendix III: Victims Killed in Khan Sheikhoun[127]

| No. | Name | Sex | Age |
|---|---|---|---|
| 1 | Melhem Jihad al-Youssef | Male | 30 |
| 2 | Yasser Ahmad al-Youssef | Male | 40 |
| 3 | Ammar Yasser al-Yousef | Male | 7 |
| 4 | Mohammed Yasser al-Youssef | Male | 10 |
| 5 | Sanaa Haj Ali | Female | 40 |
| 6 | Abdalkarim Ahmad al-Youssef | Male | |
| 7 | Ahmad Abdel Hamid al-Youssef | Male | 9 months |
| 8 | Aya Abdel Hamid al-Yousef | Female | 9 months |
| 9 | Dalal Ahmad al-Sah | Female | |
| 10 | Ibrahim Mohamed al-Youssef | Male | |
| 11 | Mohamed Hasan al-Youssef | Male | 11 |
| 12 | Hend Turki al-Youssef | Female | 69 |
| 13 | Faisal Raslan | Male | |
| 14 | Nouhad Ahmad al-Youssef | Male | |
| 15 | Malak Turki al-Youssef | Female | |
| 16 | Nour Nouhad al-Youssef | Female | |
| 17 | Hasan Mohamed al-Youssef | Male | |
| 18 | Ahmad Ibrahim al-Youssef | Male | |
| 19 | Imad al-Dein Mohamed al-Qadeh | Male | |
| 20 | Mohamed Imad al-Qadeh | Male | A child |
| 21 | Hend Imad al-Qadeh | Female | A child |
| 22 | Aboudi Imad al-Qadeh | Male | A child |
| 23 | Turki Mohamed al-Qadeh | Male | |
| 24 | Nour al-Azraq | Female | |
| 25 | Hend Turki al-Qadeh | Female | A child |
| 26 | Mohamed Turki al-Qadeh | Male | A child |
| 27 | Adnan Turki al-Qadeh | Male | A child |
| 28 | Rajaa Mohamed al-Mohamed | Female | |
| 29 | Anas al-Khalid | Male | |
| 30 | Fatima al-Soussi | Female | |

[127] The fatality list has been compiled from a range of sources including the Syria Civil Defense, the Idlib Health Directorate, and the relatives of the deceased.

| No. | Name | Sex | Age |
|---|---|---|---|
| 31 | Mustafa Anas al-Khalid | Male | A child |
| 32 | Alaa Anas al-Khalid | Female | A child |
| 33 | Shahid Anas al-Khalid | Male | A child |
| 34 | Abd al-Rahman Anas al-Khalid | Male | A child |
| 35 | Khadija Anas al-Khalid | Female | A child |
| 36 | Ahmad Khalid Halawa | Male | |
| 37 | Khalid Halawa | Male | |
| 38 | Shaimaa Ibrahim al-Jawhar | Female | A child |
| 39 | Ahmed Shahoud al-Reem Abu Mahanna | Male | |
| 40 | Najeeb al-Jawhar | Male | |
| 41 | Safiya al-Haj Youssef | Female | |
| 42 | Mayar al-Mar'i | Male | A child |
| 43 | Mohammed Mohieddin Najem al-Sayed | Male | |
| 44 | Siham Mohieddin al-Sayed | Female | |
| 45 | Ola Muhhand Makhzoum | Female | |
| 46 | Rahaf Suhail al-Youssef | Male | |
| 47 | The wife of Mohamed Najem al-Sayed, name unknown | Female | |
| 48 | Ahmad Ezzo Najem al-Sayed | Male | |
| 49 | The wife of Mustafa al-Sayed, name unknown | Female | |
| 50 | The daughter of Mazen al-Sayed, name unknown | Female | |
| 51 | Riad Khalid al-Kirowan | Male | |
| 52 | Maram Hasan Halawa | Male | A child |
| 53 | Abd al-Ghafour Maarati | Male | 35 |
| 54 | Abdallah Ghassan al-Shahna | Male | |
| 55 | Badran Abd al-Rahman al-Rahmoun | Male | 26 |
| 56 | Ahmad Hasram | Male | 27 |
| 57 | Amer al-Naif | Male | |
| 58 | Alaa al-Naif | Male | |
| 59 | Mohamed al-Naif | Male | |
| 60 | Alaa Mohamed al-Naif | Male | |
| 61 | The wife of Alaa Mohamed al-Naif, name unknown | Female | |
| 62 | The sister-in-law of Alaa Mohamed al-Naif, name unknown | Female | |
| 63 | Darar al-Alaywi Abu Imad | Male | |
| 64 | Ahmad Omar Ramadan | Male | |
| 65 | Jamila Hafez al-Qasim | Female | 55 |
| 66 | Mohamed Jamal al-Qasim | Male | 30 |

| No. | Name | Sex | Age |
|---|---|---|---|
| 67 | Faris Mohamed Sayed al-Barhoum | Male | 14 |
| 68 | Maher Mohamed Sayed al-Barhoum | Male | 12 |
| 69 | Suha al-Qassim | Female | 22 |
| 70 | Fatima Jamal Qassim al-Hamoud | Female | 15 |
| 71 | Hayyan al-Ali | Male | 40 |
| 72 | Sara al-Sleiman | Female | 32 |
| 73 | Ahmad Hayyan al-Dibbs | Male | 7 |
| 74 | Mohamed Hayyan al-Dibbs | Male | 9 months |
| 75 | Hayyan Abdallah al-Dibbs | Male | 32 |
| 76 | Yamen al-Shayeb | Male | |
| 77 | Sham al-Shayeb | Female | A child |
| 78 | Jude al-Shayeb | Male | A child |
| 79 | Mohamed al-Shayeb | Male | A child |
| 80 | Sara Mansour | Female | |
| 81 | Mustafa al-Azkour | Male | |
| 82 | Samer | Male | 18 |
| 83 | Ahmad Hosram | Male | Born in 1990 |
| 84 | Musa al-Sayed or Musa al-Hussein | Male | |
| 85 | Asmaa al-Sayed or Asmaa al-Hussein | Female | |
| 86 | Ruba Ahmad al-Saleh | Female | A child |
| 87 | Hadeel Ahmad al-Saleh | Female | A child |
| 88 | Batoul Ahmad al-Saleh | Female | A child |
| 89 | Mohamed Ahmad al-Saleh | Male | |
| 90 | Mohamed Awad Turkia | Male | |

# Appendix IV: Victims Killed in al-Salaliyah[128]

| No. | Name | Sex | Age |
|---|---|---|---|
| 1 | Saleh al-Mohamad | Male | 90 |
| 2 | Khayriah al-Saleh | Female | 80 |
| 3 | Fatima al-Mohamad | Female | 40 |
| 4 | Fatim Mohamad al-Raheel | Female | 10 |
| 5 | Israa Mohamad al-Raheel | Female | 6 |
| 6 | Ahmad Mohamad al-Raheel | Male | 2 |
| 7 | Somaa' al-Raheel | Male | 50 |
| 8 | Fadia al-Saleh | Female | 30 |
| 9 | Ghazal Ali al-Raheel | Female | 5 |
| 10 | Abdallah Ali al-Raheel | Male | 4 |
| 11 | Mohamad Ali al-Raheel | Male | 5 |
| 12 | Maysar al-Saleh | Male | 35 |
| 13 | A'tour al-Mohamad | Female | 30 |
| 14 | Dam al-Hana Maysar al-Saleh | Female | 6 |
| 15 | Ramadan Maysar al-Saleh | Male | 2 |
| 16 | Malak Maysar al-Saleh | Male | 1 |
| 17 | Daughter of Sawah al-Mohamad, name unknown | Female | |
| 18 | Daughter of Sawah al-Mohamad, name unknown | Female | |
| 19 | Mohamad Walid al-Mohamad | Male | 4 |
| 20 | Mahdi al-Mohamad | Male | 60 |
| 21 | Fasel al-Saleh | Male | 55 |
| 22 | Hakmiya Mahdi al-Mohamad | Female | 25 |
| 23 | Yaa'koub Mahdi al-Mohamad | Male | 7 |
| 24 | Youssef Mahdi al-Mohamad | Male | 5 |
| 25 | Mahdi Mahdi al-Mohamad | Male | 3 |
| 26 | Nawal al-Saleh | Female | 17 |
| 27 | Raeida Musa al-Saleh | Female | 35 |
| 28 | Hussein al-Mohamad | Male | 22 |

[128] The fatality list was compiled by a local resident.

| No. | Name | Sex | Age |
|---|---|---|---|
| 29 | Badr Hussein al-Saleh | Male | 25 |
| 30 | Kamara al-Saleh | Female | 80 |
| 31 | Ali Daher al-Musa | Male | 4 |
| 32 | Maryam Daher al-Musa | Female | 2 |
| 33 | Fatima Kassar al-Saleh | Female | 13 |
| 34 | Doha Kassar al-Saleh | Female | 9 |
| 35 | Amouna Ahmad al-Saleh | Female | 15 |
| 36 | Sabouha al-Saleh | Female | 32 |
| 37 | Zamzam Ahmad al-Saleh | Male | 12 |
| 38 | Bilal Ahmad al-Saleh | Male | 13 |
| 39 | Daughter of Ahmad al-Saleh, name unknown | Female | 4 |
| 40 | Ahmad al-Saleh | Male | 35 |
| 41 | Daher al-Moussa | Male | 35 |
| 42 | Sawah al-Mohamad | Male | 25 |

# Appendix V: Victims Killed in Jrouh[129]

| No. | Name | Sex | Age |
|---|---|---|---|
| 1 | Maryam Ali al-Mohamad | Female | 30 |
| 2 | Safa' Mohamad al-Hasan | Female | 9 |
| 3 | Hussein Mohamad al-Hasan | Male | 5 |
| 4 | Nour Mohamad al-Hasan | Female | 2 |
| 5 | Zeinab Suleiman al-Mohamad | Female | 25 |
| 6 | Raneem Munzer al-Hassan | Female | 7 |
| 7 | Yasser Munzer al-Hasan | Male | 4 |
| 8 | Mohamad Munzer al-Hasan | Male | 2 |
| 9 | Mamdouh Hasan al-Mohawish | Male | 80 |
| 10 | Sami Mamdouh al-Hasan | Male | 35 |
| 11 | Adnan Mamdouh al-Hasan | Male | 30 |
| 12 | Zaima Mohamad al-Hasan | Female | 30 |
| 13 | Mohamad Sfooq al-Hasan | Male | 40 |
| 14 | Sfooq Mohamad al-Hasan | Male | 73 |
| 15 | Leen Adnan al-Hasan | Female | 2 |
| 16 | Reem Adnan al-Hasan | Female | One month |
| 17 | Hashem Sami al-Hasan | Male | 6 |
| 18 | Reem Sami al-Hasan | Female | 5 |
| 19 | Sultan al-Awad | Male | 20 |
| 20 | Mahdi al-Hmeid | Male | 29 |
| 21 | Ahmad al-Hmeid | Male | 42 |
| 22 | Saloua al-Ali | Female | 22 |
| 23 | Khalif al-Thaher | Male | 45 |
| 24 | Abed al-Razzak al-Hussein | Male | 70 |
| 25 | Sobhiah al-Hussein | Female | 63 |

[129] The fatality list was compiled by an activist from the Syrian Revolution Coordination Committee and many names were corroborated by local residents who spoke to Human Rights Watch.


*(left) Residents of Khan Sheikhoun, Idlib province, Syria hold placards and pictures on April 7, 2017 during a protest condemning a chemical weapons attack on their town on April 4 that killed at least 92 people, among them 30 children, and left hundreds suffering symptoms including convulsions, vomiting or foaming at the mouth. Arabic slogan on the sign (R) reads: 'The chemical deal cost dozens of martyrs'.*

*©2017 Omar haj Kadour/ AFP PHOTO/Getty Images*

*(front cover) A poison hazard danger sign is seen in the town of Khan Sheikhoun, Idlib province, Syria on April 5, 2017.*

*© 2017 Abdussamed Dagul/ Anadolu Agency/Getty Images*

# DEATH BY CHEMICALS

## The Syrian Government's Widespread and Systematic Use of Chemical Weapons

All available evidence strongly suggests that on April 4, 2017, a Syrian government warplane attacked Khan Sheikhoun, a town in the northwestern governorate of Idlib, with a nerve agent, killing at least 92 people, 30 of them children. The death toll likely makes this the deadliest chemical attack since an attack killed hundreds in Ghouta, near Damascus, in August 2013. The Khan Sheikhoun attack sparked international outrage, but it was not the only recent chemical attack by the Syrian government. In fact, the government's use of chemical weapons has become widespread and systematic. In at least some of the attacks, the intention appears to have been to inflict severe suffering on the civilian population, which would amount to crimes against humanity.

*Death by Chemicals: the Syrian Government's Widespread and Systematic Use of Chemical Weapons* details new evidence pointing to government responsibility for the Khan Sheikhoun attack and identifies three recent developments that have made the Syrian government's use of chemical weapons widespread and systematic. For the report, Human Rights Watch interviewed 60 people with first-hand knowledge of the attacks and their immediate aftermath and reviewed photos and videos posted online and shared directly by witnesses.

Human Rights Watch calls on the UN Security Council to immediately demand that all parties to the Syrian conflict fully cooperate with investigators from the Organisation for the Prohibition of Chemical Weapons, and to adopt sanctions against anyone UN investigators find to be responsible for these and past chemical attacks in Syria.

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