Case Study: Syria's Chemical and Biological Weapons Program and the Use of These Weapons in the Syrian Civil War Today

By Rachel Schwartz

Introduction

Since the uprising began in Syria in March 2011, more than 100,000 people have been killed, 1.6 million people have fled the country becoming refugees, and 4.25 million people are internally displaced [1]. President Assad faces opposition from the Free Syrian Army as well as a coalition opposition group called the Syrian National Coalition [2]. The United States military believes that there are 50 chemical weapon and production sites across the country with one of the main centers at Al Safir that could be at risk. The will of Assad's forces to fight is still there, but they are struggling to combat the Syrian rebel's gains[3] until recently. At the moment there is a constant flux in who maintains the upper hand, but for the first time there is a sway in the power scale towards the Syrian regime. It is believed that the Alawites, the minority ruling party lead by president Bashar al-Assad, were desperate enough to use anything in their power to stay the ruling government, including use of any of the binary gases[4] which was the case this past March through May. With this constant uncertainty of which party, faction, or militia will hold Syria's vast chemical weapons stores, it is important to review Syria's chemical weapons history

[1] "Report of the Independent International Commission of Inquiry on the Syrian Arab Republic. Twenty third session, agenda item 4" *Human Rights Council*,. http://www.ohchr.org/Documents/HRBodies/HRCouncil/CoISyria/A-HRC-23-58_en.pdf

[2] Syria crisis: Nato approves Patriots for Turkey. BBC News. 4 Dec 2012. http://www.bbc.co.uk/news/world-middle-east-20590129

[3] Mount, Mike. U.S. concerned Syria "cooking up recipes" for chemical weapons. CNN. 4 Dec 2012. http://security.blogs.cnn.com/2012/12/04/u-s-concerned-syria-cooking-up-recipes-for-chemical-weapons/?iref=allsearch

[4] What's our next move in Syria?. CNN. 4 Dec 2012. Web. http://www.cnn.com/video/#/video/bestoftv/2012/12/03/exp-erin-syria-red-line-panel.cnn

and development to understand where the chemical and biological weapons are being stored and used today.

Definition of Chemical and Biological Weapons

Chemical and biological weapons are "weapons whose intended means for causing harm is either the toxicity of chemicals or the infectivity of disease-causing micro-organisms"[5]. They are "designed to disseminate pathogens or toxins in an aerosol cloud of microscopic particles that can be readily inhaled and retained in the lungs of the exposed population"[6]. In Article II of the 1993 Chemical Weapons Conventions, chemical toxins are described as "any chemical, which through its chemical action on life processes can cause death, temporary incapacitation or permanent harm to humans or animals"[7]. These pathogens can be disseminated through "bomblets loaded into cluster bombs or missile warheads or by spraying devices that are mounted on aircraft, helicopters, cruise missiles, ships, or vehicles, or that are carried by hand"[8], all effective means in reaching desired populations. Most state actors choose chemical and biological weapons for their key destabilizing features and other alleged benefits. Chemical and biological weapons have two effects: physical and psychological. At the tactical level, these weapons "can influence the shape and outcome of battle… and used strategically…can produce physical and psychological effects that may undermine moral and produce a decision to end the conflict"[9] including burns, paralysis, and hallucinations.

Syrian Chemical and Biological Weapon Development

Syria began its chemical weapons program after its defeat in the 1967 Six Day war, the 1973 Yom Kippur War, and the 1982 Lebanon War by Israel. Faced with the subversive pressure

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[5] Busch, Nathan E., and Daniel Joyner. *Combating Weapons of Mass Destruction: the Future of International Nonproliferation Policy.* Athens: University of Georgia Press, 2009.

[6] Koblentz, Gregory. "Pathogens as Weapons." *International Security*, 2003. Vol. 28 No. 3. Pp. 84-122. Web.
[7] Busch, Nathan E., and Daniel Joyner.
[8] Koblentz, Gregory.
[9] McNaugher, Thomas L. "Ballistic Missiles and Chemical Weapons: The Legacy of the Iran-Iraq War." *International Security* 15.2 (1990): 5-34. *Project MUSE*. Web. http://muse.jhu.edu/

from its neighbor, Syria sought to counter Israel's military prowess and its nuclear capability. Unable to counter with a nuclear option itself, Syria focused on a more attainable non-conventional deterrent- chemical and biological weapons [10]. In the initial engineering of its chemical weapons program, Syria was "aided by its neighbors, allies, and European chemical wholesalers"[11]. Syria was heavily dependent on outside help in "procuring important precursor chemicals and equipment from Russia, Egypt, West Germany, France, Iran, North Korea, and possibly other countries over a period of 20 years"[12]. Egypt, like with many other chemical weapons programs at the time, is believed to be the first government to contribute to the inauguration of Syria's chemical weapons program in 1973 by giving mustard gas[13] as well as "artillery shells capable of delivering chemical weapons" [14]. However, after the Yom Kippur War Syria began to produce its own weapons and intensified its program further after the Camp David Agreements in 1978 and the Israeli-Egyptian Peace Treaty in 1979[15]. It is believed Syria started locally producing mustard gas in the 1980s in bulk as well as starting the production of sarin[16]. The French most likely spurred the production of sarin by exporting pharmaceuticals to Syria. Some of the exported pharmaceuticals to Syria were "dual use" chemicals, which means they can also be used for chemical weapons production. It is believed that methylphosphonyl diflouride and isopropanol, precursors for sarin, were amongst the pharmaceuticals given [17].

The vast majority of chemical and biological weapons production technology came from "large chemical brokerage houses in Holland, Switzerland, France, Austria, and Germany". However, in 1985 the Australia Group, " a 40-nation body that seeks to curb chemical and biological weapons through export controls" of dual-use equipment and materials, made it

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[10] Pita, Rene. "Analysis of Syria's Chemical and Biological Threat." *Instituto Espanol de Estadios Estrategicos.* 14 April 2012. Web. http://www.ieee.es/en/Galerias/fichero/docs_opinion/2012/DIEEEO33-2012_AnalisisAmenazaQuimicaBiologicaSiria_RenePita_ENGLISH.pdf

[11] Deutsch, Anthony and Khaled Yacoub Oweis. "Syria's Chemical weapons program was built to counter Israel". *Reuters*. 5 June, 2013. Web. http://www.reuters.com/article/2013/06/04/us-syria-crisis-chemical-idUSBRE9530QC20130604

[12] Edwald, William. "The Syrian Crisis and Chemical Weapons." *Indian Defense Analysis.* 1 July 2012. Web. http://defenceforumindia.com/syrian-crisis-chemical-weapons-451

[13] "Syria's chemical weapons stockpile and human impact." *BBC News.* 26 April 2013. Web. http://www.bbc.co.uk.wp.test.ebaytoday.ru/news/world-middle-east-22307705

[14] Edwald, William.

[15] Pita, Rene.

[16] "Syria's chemical weapons stockpile and human impact."

[17] Deutsch, Anthony and Khaled Yacoub Oweis.

increasingly harder to secure raw chemicals in the international market place forcing Syria to look toward Russia, Iran, and North Korea to get supplies[18].

Chemical Weapons Links to the USSR

In 1992 the Soviet Union and Syria entered into a "cooperation agreement" in which the Scientific Studies and Research Center, Syria's chief research center, and the State Scientific Research Institute of Organic Chemistry and Technology (GOSNIIOKhT), the main institute for the development of a new nerve agent called Novichok, came together to create an alleged environmental protection center. In reality, the Soviet Union would provide materials for the production of nerve agents, specifically sarin, to Syria and they would work in conjunction to develop Novichok. Novichok was of particular interest at the time because its chemical precursors were "neither included in the list of chemical substances submitted to the CWC verification measures, nor in the verification inspections of the Organization for the Prohibition of Chemical Weapons" [19]. This is when it is suspected that former Russian general Anatoly Kuntsevich smuggled the precursor chemicals for VX gas production to Syria.[20] Kuntsevich also managed the chemical weapons research center located in Shikbany from 1975 to 1983 where the chemical agent Novichok was tested. However, the main goal of the agreement continued to be the transfer of sarin to Syria.

The Soviet Union also supplied Syria with missiles ranging from the initial FROG-7 missiles with a range "only 70 km and their accuracy low" to the Scud-B missiles in 1974 and to the SS-21 Scarabs in 1983 "with ranges of 300 km and 70-120 km respectively". Not long after in the 1990, Syria established an agreement with North Korea for the "supply of Scud-C missiles (range of 550-700 km and CEP of 50-700m) and in the year 2000, Scud-D missiles were supplied".[21] This agreement alone allowed Syria to have the ability to attack Israel's main cities significantly increasing its regional clout over Israel.

[18] Deutsch, Anthony and Khaled Yacoub Oweis.
[19] Pita, Rene.
[20] Deutsch, Anthony and Khaled Yacoub Oweis.
[21] Pita, Rene.

Chemical Links Between Syria and North Korea

North Korea has most likely had a presence in Syria since the early 1990s, especially after the weakening of relations between the USSR and Syria in the 1980s. In regards to conventional weaponry North Korea built two missile assembly facilities in Syria by 1993 or 1994, "which have since been producing 30 to 50 Scuds a year." In terms of non-conventional weaponry, North Korea later built at least two chemical weapons production factories "capable of producing at a minimum, VX and sarin." [22]

Chemical Weapons Links to China

In order to attain M-9 missiles from China, Syria established open contact with them in 1989. It is unclear whether the missiles were ever shipped directly to Syria or whether China instead gave Syria the needed technological knowledge in order for Syria to have the capability to produce the missiles on its own. The M-9 missiles have a firing range of 600km and CEP of 280-600m.[23]

Syria's Chemical and Biological Weapons Stockpiles

Chemical and biological weapons have gained a reputation in the Middle East as an accessible means of defense, deterrence, and in recent cases offense. They are used to increase the power of a state amongst its own people as well as both within the region and amongst those on the international stage. Due to the constant instability that characterizes this region of the world, national actors are constantly looking for means to protect themselves and enforce a persona of power and confidence to prevent being taken advantage of by their citizens, neighbors or international powers, especially the United States. In many cases, however, these regimes or governments do not have the financial capital to invest in nuclear programs and instead, in order to balance the perceived weapons threats from the countries around them, focus on "the poor

[22] Alabaster, Olivia. "North Korea boosting ground to support regime." *The Daily Star.* 8 June 2013. Web. http://www.dailystar.com.lb/News/Middle-East/2013/Jun-08/219763-north-korea-boosting-ground-support-to-regime.ashx
[23] Pita, Rene.

man's nuclear weapon,"[24] chemical and biological weapons. Syria fits this profile exactly because it first garnered means to develop a chemical weapons program in response to its defeat against Israel in the 1967 Six Day War and Israel's growing nuclear arsenal. Therefore Israel became a major threat within the region to Syria, especially regarding the struggle over the Golan Heights that was taken from Syria in the 1967 War. This is further exemplified by Syria's refusal to sign the Chemical Weapons Convention until Israel signs the Non-Proliferation Treaty or until there is progress regarding a regional ban or free zone against weapons of mass destruction.[25] Even recently the Syrian government run by Bassar al-Assad has turned "to the default of 'asymmetric' warfare, [including] chemical warfare, to compensate for [its] conventional shortcomings"[26] in maintaining power against Syrian rebel fractions and its own citizens.

Since its initial meek beginnings, Syria has been able to acquire an "offensive chemical weapons capability that continues to be the regime's strategic deterrent against Israel."[27] The Center for Nonproliferation Studies has stated "Syria has one of the largest chemical weapons arsenals, including traditional chemical agents, such as mustard, and more modern agents, such as Sarin, and possibly persistent nerve agents, such as VX."[28] The United State's Director of National Intelligence confirmed as well in his 2012 report that Syria was developing VX.[29] While the official size of the chemical weapons stockpile is unknown, Syria could be up to "a combined total of a few hundred tons of chemical agent per year."[30] Another statement released by the Indian Defense and Security Analysis report asserts that using the numbers given by the Turkish, Arab, and Western intelligence agencies, Syria has accumulated since the 1980s a "stockpile of approximately 1,000 tons of chemical weapons, stored in some 50 different cities,

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[24] Russell, Richard L. Iraq's Chemical Weapons Legacy: What Others Might Learn from Saddam. *Middle East Journal*. Vol. 59 No. 2. Changing Geopolitics. Spring, 2005. pp. 187-208. Jstor. http://www.jstor.org/stable/4330124

[25] Phillips, Keri. "Our Love affair with chemical weapons." *ABC.* 27 May 2013. Web. http://www.abc.net.au/radionational/programs/rearvision/chemical-weapons/4715782
[26] Russell, Richard L.
[27] Ewald, William.
[28] Marcus, Jonathan. Fears grow for fate of Syria's chemical weapons. BBC News. 5 Dec 2012. Web. http://www.bbc.co.uk/news/world-middle-east-18483788
[29] Pita, Rene.
[30] Katz, Yaakov. "Ministry holds off on gas mask distribution. Fears move could be interpreted as preparation for war" *Jerusalem Post.* 11 Sept 2007. Web.

mostly located in the northern part of the country that is closer to the Turkish border."[31] The CIA in itself has stated that Syria has a variety of platforms in its arsenal that can be used to deliver its chemical weapons including aerial bombs, artillery shells and rockets, and ballistic missiles. In 1993 Syria was even the first to produce "tube and rocket artillery rounds filled with mustard-gas-type blistering agents…the first weaponization of its kind."[32]

Syria's chemical and biological weapons were designed for large-scale military use. Much of Syria's chemical weapons are "binary, or stored as two separate ingredients that must be combined before lethal use," making it hard for its detonation by groups other than the Syrian government forces. For instance, when a nerve gas shell is fired, its two compartments mix together due to the force of the blast and the shell's rotation mixes the two chemicals creating a lethal byproduct. However, not all of Syria's weapons are binary, such as blistering agents, and all can be ignited with rudimentary explosive devices.[33]

Nonetheless, in 2009 Syria initiated a renovation of its known facilities, specifically in regards to building new warehouses and manufacturing facilities that are able to create complex chemical materials. These warehousing and manufacturing buildings have "sophisticated filtration systems and cooling towers [and] bays for specially adapted Scud missiles."[34] This is critical because it means that since 2009 Syria has been amassing a larger chemical weapons arsenal then before and engineering more complex chemical compounds. With this escalation in the amount and types of chemical weapons produced it can be deduced that there is an increased likelihood that Assad is looking to create a more forceful position of power for Syria in the Middle East. This could include an extension into growing their biological weapons research and development, which has been inconclusive in its existence to the outside international community.

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[31] Ewald, William.
[32] "Syria's chemical weapons stockpile and human impact."
[33] Crowley, Michael. "What if Al Qaeda Gets Syrian Chemical Weapons?" *CNN.* 7 May 2013. Web. http://swampland.time.com/2013/05/07/what-if-al-qaeda-gets-syrian-chemical-weapons/

[34] McElroy, Damien. "Syria 'rebuilding' chemical weapons capability." *Telegraph.* 18 Feb 2009. Web. http://www.telegraph.co.uk/news/worldnews/middleeast/syria/4691464/Syria-rebuilding-chemical-weapons-capability.html

Syrian Biological Weapons

While Syria ratified the 1925 Geneva Protocol in 1968, which prohibits "the use in war of asphyxiating, poisonous or other gases, and of bacteriological methods of warfare" (Geneva Protocol), it has yet to ratify the 1997 Chemical Weapons Convention and the Biological and Toxin Weapons Convention (BTWC) treaty which it signed in April 1972. This lack of transparency has made it indeterminate to confirm irrefutably that Syria is conducting research in biological weaponry. While there have been countless accounts of chemical weapons research, production, and storage, there have been no known acknowledgements in open sources of a biological weapons program in Syria or of its size and scale. The only account of a defensive biological weapons capability is recorded in the early 1970s where Syria acquired "modern Soviet land warfare systems such as tanks and armored personnel carries that included standard NBC protective equipment," and since then they have not declared any other investments in biodefense.[35]

The Centre d'Études et de Recherches Scientifiques (CERS), located outside of Damascus, has been indicated as the primary location of an active offensive biological weapons program.[36] It is also believed that the research facility located at Cerin is active in biological weapons research and production. Between these two sites, NATO Defense Establishment consultant Dr. Jill Dekker has sated that Syria has worked on "anthrax, plague, tularemia, botulinium, smallpox, alotoxin, cholera, ricin, and camelpox, and has used Russian help in installing anthrax in missile warheads."[37] DIA Director Lt. General Michael Maples testified in March 2009 "that "we judge some elements of the program may have advanced beyond the research and development stage and may be capable of limited agent production." [38] However, as the U.S. Director of National Intelligence stated in the 2011 report, while Syria has the means to weaponize biological agents in an effective delivery system by modifying conventional and chemical weapon systems it seems they have yet to achieve this capability.[39]

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[35] Syria. *Nuclear Threat Initiative.* Feb 2013. http://www.nti.org/country-profiles/syria/biological/
[36] Syria
[37] "Syria's Bio-Warfare Threat: an interview with Dr. Jill Dekker". New English Review. 16 July 2012.
[38] Syria
[39] Pita, Rene.

However, Dr. Jill Dekker indicates, unlike the U.S., that Syria has a robust biological weapons program that developed its capability from the Russian, North Korean, Iran, and the former Iraq's biological weapons programs. According to her research, there are multiple programs being run in Aleppo as well as at CERS. Syria is also understood to have and be researching pathogens and toxins from categories A, B, and C. They received some of these pathogens and dual-use technologies legally from biopharmaceutical companies, like Baxter, or illegally from other countries. For instance, Dr. Dekker claims that Syria received camelpox from Iraq's problematic program. She even claims that they have mastered different types of dispersal methods such as micro-encapsulation, which is critical for aerosol dispersal.[40] This is a very contentious view, however, and is disagreed with by the U.S. and the Nuclear Threat Initiative among others.

Syria's Biotechnology and Pharmaceutical Sector

Syria's biotechnology and pharmaceutical infrastructures could support the production of biological agents creating a dual-capable system. After the boom of producing chemical weapons locally in Syria in the early 1980s, this innovation spilled over into the industrial pharmaceutical and biotechnology sectors in the late 1980s. In 2010, Syria was home to more pharmaceutical companies than any Arab country, including "eight or nine large firms practicing modern production techniques, 25 midsized companies producing generics, and 25 factories of limited functionality." Within twenty years the industrial base went from supplying only 6% of national demand to being a multi-million dollar industry supplying 90% of national demand. "In 2011, Syria's pharmaceutical industry included claimed an estimated output valued at $500 million, $350 million of which was consumed in the domestic market." At their height, "Syria's pharmaceutical companies produced 5,700 types of products and employed a workforce of 17,000."[41] The materials are imported from North Korea, Russia, and Europe.[42] Products ranged from antibiotics, antifungals, antivirals, and vitamins. Investment is mostly on generic drugs and not on novel research. It is important to recognize that Syria "has an organizational capacity to

[40] "Syria's Bio-Warfare Threat: an interview with Dr. Jill Dekker."
[41] Syria
[42] Pita, Rene.

develop modern scientific production facilities,"[43] and achieve limited biological agents development according to U.S. government assessments, but it has not been declared the program exists or is viable.

Chemical and Biological Weapons Possessors in Syria

The secrecy behind a country's use of chemical weapons is the main cause of destabilizing effects. "Not only does it impede verification, but it also undermines deterrence, hinders civilian oversight, and significantly complicates threat assessments."[44] Like Iraq during the regime of Saddam Hussein, Bashar Assad and Syria's chemical and biological weapons programs and investments are unbeknownst to the world. This is even more critical because unlike Iraq, Syria has not jointed the Chemical Weapons Convention and so has not had to make any formal declarations of its stockpiles.[45] Until July 23rd, 2012 when the Syrian government implicitly acknowledged possessing stocks of chemical weapons and that they were reserved only for national defense against foreign countries,[46] there had been no admittance from Syria that it had chemical weapons. It was not until it was suspected that Assad was preparing to use chemical weapons in December 2012 and then their use in at least four Syrian towns so far that we had proof of Syria's chemical weapons.

The conflict that began more than two years ago in early 2011 as a series of pro-reform demonstrations against the Baathist party has now become the first civil war in a country where vast chemical and biological weapons stores are known to be located. This has created considerable strife for the citizens of Syria because of the unfortunate use of these chemical weapons and the decentralization of security surrounding the chemical weapons stores. The man that is currently overseeing the chemical weapons security is special security advisor Ali Mamlouk. Assad has lost overall command and control as the war has progressed according to a defector from the chemical weapons units. The chemical weapons stores are now "in the hands

[43] Syria
[44] Koblentz, Gregory.
[45] Marcus, Jonathan.
[46] MacFarquhar, Neil. "Syria Says Chemical Arms Reserved for Attack From Abroad". *New York Times*. 23 July 2012. http://www.nytimes.com/2012/07/24/world/middleeast/chemical-weapons-wont-be-used-in-rebellion-syria-says.html?pagewanted=all&_r=0

of chemical weapons-trained loyalists of Assad's Alawite clan…[and] most of the chemical weapons have been transported to Alawite areas in Latakia and near the coast", so as to fire them using medium range surface-to-surface missiles. This means that irregular militias, who have the possibility to defect from the regime's control, will have the knowledge to use these chemical ammunitions. Other chemical weapons remain in bases around Damascus and the chief research center CERS "and have been deployed with artillery shells."[47]

The Syrian government military has strategically focused on solidifying control of major urban cities and main supply routes and lines of communications between the most strategic areas. The government forces have been able to hold all major cities, except Al-Raqqah, "despite facing serious challenges in Aleppo, Dara'a and Dayr Al-Zawr." Currently, the Syrian government forces are launching operations in Aleppo, Dara'a, Homs, and Damascus.[48] In Aleppo, Assad forces control the western half of the city, while in Homs Assad officials reported they have overhauled the Khaldiveh district as opposition spokesmen deny this declaration.[49] However, opposition forces have cemented control over northern and eastern governorates[50] and are continuously trying to overrun Syrian weapons depots, which they have not succeeded to do except for the suspected take over of a factory outside of Aleppo by al-Nusra in August 2012.[51] Opposition forces were also found to control two containers of sarin in a raid by Syrian government forces on a militant hideout in al-Faraich, Hama.[52] From this we can infer loosely that the chemical weapons stores located in the major cities as well as near Latakia on the coast are held and controlled by Syrian government forces or related militia. In areas near the major cities in flux however, it is unclear who holds these facilities.

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[47] Deutsch, Anthony and Khaled Yacoub Oweis.
[48] "Report of the Independent International Commission of Inquiry on the Syrian Arab Republic. Twenty third session, agenda item 4"
[49] "Arab World." *Foreign Policy.* 15 July 2013. Web. http://mideast.foreignpolicy.com/category/region/arab_world
[50] "Report of the Independent International Commission of Inquiry on the Syrian Arab Republic. Twenty third session, agenda item 4"
[51] Baker, Aryn. "Syria's Civil. War: Mystery Behind a Deadly Chemical Attack." *CNN.* 1 April 2013. Web. http://world.time.com/2013/04/01/syrias-civil-war-the-mystery-behind-a-deadly-chemical-attack/
[52] "Syrian Army seizes Sarin gas from rebels." *ZeeNews.* 3 June 2013. Web.

Current Weapons Stockpiles

Much information is still unknown about the location of the chemical weapons. Are they stored in mass quantities? Are they stored in heavy artillery shells or missile heads? Are they located in close proximity to each other? General Martin Dempsey, chairman of the Joint Chiefs of Staff, announced in April that the Syrian government keeps moving the chemical weapons,[53] specifically its stocks of sarin and mustard gas from storage sites to trucks.[54] It seems that the Syrian government is consolidating its chemical arsenal into fewer locations because in December American intelligence agencies indicated that there had been significant movement of chemical weapons stores as well as indications that the Syrian government had been mixing chemicals.[55] Following the advice of their Russian military cohorts in order to ensure security and safety, the Syrian government consolidated their weapons depots into two to four main storage facilities.[56]

Sites

Syria's chemical and biological weapons arsenal can be divided into four types of facilities- Production, Research and Development, Dual-Infrastructure, and Storage. The Nuclear Threat Initiative has compiled comprehensive and current information on the sites that are active and known today, which can also be verified by other open sources. Western nonproliferation specialists have indicated that chemical weapons production facilities are located at approximately 5 sites including al-Safira, Hama, Homs, Latakia, and Palmyra,[57] with sarin and VX thought to be produced at al-Safira, Hama, Homs, and Latakia. Syrian storage facilities are

[53] Vandiver, John. "Troops needed to secure Syria's chemical weapons, some experts say." *Stars and Stripes.* 29 May 2013. Web. http://www.stripes.com/news/troops-needed-to-secure-syria-s-chemical-weapons-some-experts-say-1.223510
[54] The Tower Staff. "Israeli Air Strikes Reported As Both Rebels and Hezbollah Close In on Syria's Chemical Weapons." *The Tower.* 3 May 2013. Web. http://www.thetower.org/israeli-air-strikes-reported-as-both-rebels-and-hezbollah-close-in-on-syrias-chemical-weapons/
[55] Baker, Peter; Mark Landler and David E. Sanger. "bama's Vow on Chemical Weapons Puts Him in Tough Spot." *NYTimes.* 11 June 2013. Web. http://www.nytimes.com/2013/05/05/world/middleeast/obamas-vow-on-chemical-weapons-puts-him-in-tough-spot.html?pagewanted=all
[56] "Syria 'secures chemical weapons stockpile'". *Aljazeera.* 23 Dec 2012. Web. http://www.aljazeera.com/news/middleeast/2012/12/201212221532021654.html
[57] Pike, John. "Special Weapons Facilities". *Global Security.* 5 June 2011. Web. http://www.globalsecurity.org/wmd/world/syria/facility.htm

located at least at al-Furqlus, Dumayr, Khan Abu Shamat, and the Scientific Studies and Research Centre. Many of these sites are known to the international community and have been targeted specifically by Israel.[58]

Chemical: Production

Hama- The production site of Hama is located 47 kilometers north of Homs and 140 kilometers south of Aleppo. The facility was established and began producing missiles in 1993 as a Scud-3 and today is under the direct control of the Centre D'Etudes et de Recherchés Scientifiques (CERS).

Hims- Located outside the perimeter of the Homs Refinery. Also called Homs and is subordinate to CERS.

Lattakia- Located on the Syrian northern coast and is subordinate to CERS. Also known as Latakia environs.

Al-Safira- Alternates names: As Safirah, Al Safir, Safiyah, Aleppo, Location: Al-Safira is located in the northwest of the country on a ridge 1 kilometer south of Al Safira and 20 kilometers southeast of Aleppo and is four by eight kilometers big. It was established in 2005, and is one of the premier chemical weapons facilities for production, storage, and weaponization including sarin.[59] Images of al-Safira indicate that it is protected by modern surface-to-air missiles, which were allegedly given to them by Russia.[60]

Research and Development

Centre D'Etude et Recherche Scientifique- Alternate names: CERS, Scientific Studies and Research Center. The Scientific Studies and Research Center located in Damascus is the principal facility in Syria for both chemical and biological research, development, testing,

[58] Pita, Rene.
[59] Syria.
[60] McElroy, Damien.

production, and storage. The research center first concentrates on "upgrading chemical and biological war agents and, second, upgrading dispersal and delivery systems for those agents."[61] It also works on research for a variety of different weapons. CERS has worked closely with the Syrian military for over 40 years[62] and reports directly to the president, Bashar al-Assad. It is in charge of operating several other chemical production facilities that have been listed above. For over a decade, the Scientific Studies and Research Center has been the focus of western sanctions in Syrian weapons production, and recently on February 3rd, 2013 it was bombed by Israel, although it had protection from antiaircraft weapons, suffering moderate damage. It still continues to be operational today.[63]

Jamraya- Located northwest of Damascus. Jamraya was established in the 1980s with help from the Soviet Union. It is the most clandestine and highest profile research and development center in Syria. It is home to some of the most important strategic military bases in Syria and critical weapons are developed and stored there.[64] On May 3rd and 5th, 2013 Israel used its surface-to-surface missiles to strike the research center and cause irremediable damage while destroying believed m600s missiles shipment headed to restock Hezbollah arsenals.[65]

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[61] "Syria's Bio-Warfare Threat: an interview with Dr. Jill Dekker."
[62] Rudoren, Jodi, David E. Sanger, and Eric Schmitt. "Israeli Strike Into Syria Said to Damage Research Site." *New York Times.* 3 Feb 2013. Web. http://www.nytimes.com/2013/02/04/world/middleeast/syrian-weapons-center-said-to-be-damaged.html
[63] Syria.
[64] "Profile: Syria's top-secret Jamraya research centre." *BBC.* 5 May 2013. Web. http://www.bbc.co.uk/news/world-middle-east-22421732
[65] Piyen, Ben. "Timeline: Israeli attacks on Syrian targets." *Aljazeera.* 5 May 2013. Web. http://www.aljazeera.com/indepth/features/2013/05/20135512739431489.html

Image 1- A picture of the damage done to a parking lot at the Jamraya research center. The buildings appear to have been largely left intact [Aljazeera]

Image 2- The Syrian military research centre at Jamraya [Aljazeera]

Dual-use infrastructure

Setma Limited- Located in the Damascus area, and is subordinate to the Syrian government

Homs General Fertilizer Company- Located on the shore of Lake Katina in Katina, a district of Homs, southwest of the city's center. It is subordinate to the Syrian government and General

Establishment for Chemical Industries (GECI). It is composed of three separate facilities for fertilizer production, two sulfuric acid plants, and an anhydrous ammonia plant. Its status is operational.

Homs Oil Refinery- Alternate names: Homs Refinery Company and Syrian State Petrol Company. It is located approximately 5 kilometers west of the center of Homs inside ring road. It is subordinate to General Corporation for Oil Refining and Distribution of Petroleum and it refines approximately 5.7 million tons annually, or 120,000 barrels daily. Its status is operational.

Banias Oil Refinery- Also called Banias Refinery Company and is located in the city of Banias. It is subordinate to Sytrol, General Corporation for Refining and Distribution of Petroleum Products, and the Ministry of Petroleum. It refines approximately 6 million tons of crude oil per year or 133,000 barrels per day. Its status is operational.[66]

Storage

Khan Abu Shamat Depot- Lcated approximately 20 kilometers east of Dumayr and is subordinate to the Syrian government

Furqlus Depot- Located approximately 40 kilometers southeast of Homs and 4 kilometers northeast of al-Furlqlus. It is subordinate to the Syrian government.

Masyaf- Located approximately 7 kilometers northeast of Masyaf and is subordinate to CERS.

Palmrya- Located northeast of Damascus, but its status is questionable.

Dumayr- Located 40 kilometers northeast of Damascus, but its status is questionable.[67]

[66] Syria.
[67] Syira.

Biological Weapons

Research and Development

Centre D'Etude et Recherceh Scientifique (CERS)- The Scientific Studies and Research Center runs the chief biological weapons program in Syria. The facility has different wings for each distinct pathogen, and is currently researching how to cultivate highly virulent anthrax in order to install it in missile warheads. As stated previously, category A pathogens anthrax, plague, tularemia, botulinium, smallpox, alotoxin, cholera, ricin, and camelpox have also been researched at this facility,[68] and it is considered the primary location of an active offensive biological weapons program.[69]

Chemical Weapons Transfers between Syria and Terrorist Groups

Links between Syria and Hezbollah have been further cemented by the recent military victory over rebel forces in al-Qusayr. Syrian support for Hezbollah has included armament supply. Moreover, Syria has often acted as a transit point for arms originating in Iran on their way to Hezbollah.[70] Hezbollah is apparently in control of over 40,000 rockets and missiles, which include ones with a range sufficient of striking most of Israel. This includes the Dimona nuclear reactor, as well as military facilities.[71]

Of further concern to Israeli security forces is the possibility of Syria transferring chemical weapons to Hezbollah; some officials already believe this to have taken place.[72] Despite this, it is unclear whether Hezbollah or affiliated terrorist groups have the capacity and competence to utilize such weapons.[73]

Despite this, Israeli forces have targeted both weapons facilities and transfers. In January 2013, a chemical and biological weapons research facility was attacked by warplanes. In the

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[68] Syria's Bio-Warfare Threat: an interview with Dr. Jill Dekker."
[69] Syria.
[70] Ewald, William.
[71] Melman, Yossi. "ANALYSIS: Israel's Brinkmanship Strategy: Acting to Prevent Regional Deterioration." *The Tower.* 7 May 2013. Web. http://www.thetower.org/analysis-israeli-brinksmanship-aimed-at-preventing-regional-deterioration/
[72] The Tower Staff.
[73] Vandiver, John.

same month, a military convoy allegedly delivering SA-17 missiles to Hezbollah was also hit.[74] In May, two further operations struck Fateh-110 missiles, including Iranian made surface-to-surface missiles that were also allegedly meant for Hezbollah.

The fear of terrorist organizations ability to gain such weapons also extends to the Free Syrian Army, who might supply such weapons to regional terrorist groups.[75] While openly opposed to the Syrian regime, al-Qaeda linked Jabhat al-Nusra also poses a serious security concern. Many al-Nusra factions are considered to be within attacking range of WMD caches, and should they succeed in capturing them, Israeli security forces have publicly voiced concern over the possibility of them being utilized against Israeli targets. Also wary to their threat is the Syrian regime itself. When al-Nusra rebels fought their way towards a chemical weapons cache near Aleppo, regime figures considered the threat strong enough to transport the weapons to a different location.[76]

In Iraq, al-Qaeda linked insurgents utilized chlorine bombs in 2006 and 2007 by incorporating them into traditional car bombs. Al-Nusra's similar link to al-Qaeda poses concerns over whether they will also utilize chemical weapons in Syria, and aids Assad's rhetoric that Islamist rebels are behind the countries civil war.[77]

Chemical and Biological Weapons in Syria

The element of surprise is the most attractive factor of chemical and biological weapons to Arab states because of the strategic military gains one can achieve through surprise and unknown attacks. The difficulty of detecting biological weapons specifically makes them well conditioned for surprise attacks, especially aerosols, which are conducive for clandestine attacks because they are tasteless, odorless, and invisible. Also, the difficulty in determining which type of chemical or biological agent is being used also makes these weapons favorable. Biological weapons are highly diverse and can be novel pathogens. This makes it difficult to establish if

[74] Lieberman, Ari. "Russia and Iran Stoke the Flames of War." *FrontPage Magazine.* 4 June 2013. Web. http://frontpagemag.com/2013/ari-lieberman/russia-and-iran-stoke-the-flames-of-war/
[75] Ewald, William.
[76] Crowley, Michael.
[77] Baker, Aryn.

there is an outbreak due to the diverse reactions and early symptoms of most pathogens and to effectively defend against these toxins.[78] This is currently the case in Syria where there is contention and confusion in the international community over which group was responsible for the use of the chemical weapon sarin against the Syrian people. Until recently, it was hard to declare that Assad had used chemical weapons because it was hard to discern if the evidence delivered to Turkey, Israel, France, Britain, and the United States was credible due to its uncertain origin, time, way of delivery, and accessibility to the region since Syria's borders are currently blocked off from the international community entering legally.

In December Assad tested the waters internationally by using limited chemical weapons allegedly against the town of Baba Amr and threatened to use them in al-Zabadani by giving gas masks to government troops.[79] When there were no international consequences and he gained power from the maneuver, Assad then more strategically used chemical weapons in at least four instances between March and May. According to the June 13th White House statement, chemical weapons use has resulted in an estimated 100-150 deaths in Syria.[80] This "last-ditch effort" to defeat the rebels worked because Syrian government forces and militias have since gained ground by conquering the essential city of Qusair and are now working to take over Homs, another strategically critical city for supply lines. Rebel forces are currently receiving a blow and are losing the city piece by piece. However, there are also allegations that both parties have used chemical weapons against Syrian citizens since the beginning of this year, but the majority concern is their use by Assad forces.[81]

Areas in Which Chemical Weapons Have Been Used

Allegations continue concerning the use of chemical weapons by both parties. Six attacks have been reasonably confirmed in the use of chemical weapons, and up to 13 have been reported yet unverified. However, the primary concern has been their use by Syrian government

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[78] Koblentz, Gregory.
[79] "Assad regime distributed gas masks and radiation suits to troops." *Asharq-Alawsat*. 6 December 2012. Web. http://www.aawsat.net/2012/12/article55239621
[80] Feickert, Andrew, Paul K Kerr, and Mary Beth Nikitin. "Syria's Chemical Weapons: Issues for Congress." *Congressional Research Service.* 1 July 2013. Web. http://www.fas.org/sgp/crs/nuke/R42848.pdf
[81] "Russia Criticizes UN Report on Syrian Human Rights Abuses." *RiaNovosti.* 4 June 2013. Web. http://en.rian.ru/russia/20130604/181503953.html

forces. It is believed that in four attacks –1) Khan Al-Asal, Aleppo, March 19th; 2) al-Otaybeh, Damascus, March 19th; 3) Sheikh Maqsood, Aleppo, April 13th; and 4) Saraqib, Idlib, April 29th – there are reasonable grounds to believe that limited quantities of toxic chemicals were used. "It has not been possible, on the evidence available, to determine the precise chemical agents used, their delivery systems or the perpetrator."[82]

December 23rd- Homs

On Dec. 23, 2012, an attack in Homs province killed seven and wounded more than 50. The inhalation of poisonous gases was determined as the source of deaths following an alleged attack by Syrian government forces, though this has yet to be confirmed. According to one IDF official, this would be a "test of the world's reaction."[83]

The symptoms of those affected suggest that the Syrian regime utilized the BZ nerve gas, also known as Agent 15. According to Dr. Nashwan Abu-Abdo, symptoms included asphyxiation and several seizures[84].

March 19th- Khan al-Assal

Following the March 19th events in Khan al-Assal, both sides called for an inquiry into what is believed to have been a chemical weapon attack. The alleged attack in the northern town killed a reported 31 people and caused symptoms in roughly 300 others. Both sides continue to blame each other for the attacks[85][86][87]

Sana, the Syrian state news agency blamed the attack on "terrorists" who had fired

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[82] Pita, Rene.
[83] Baker, Peter.
[84] Spencer, Richard. "Syria Homs Attack Might Have Included Use of Chemical Weapons". *The Telegraph* http://www.telegraph.co.uk/news/worldnews/middleeast/syria/9806675/Syria-Homs-attack-may-have-included-use-of-chemical-weapons.html
[85] Panell, Ian. "Syria conflict: BBC shown 'signs of chemical attack'." *BBC News.* 16 May 2013. Web. http://www.bbc.co.uk/news/world-middle-east-22549861
[86] "Syria chemical weapons allegations." *BBC News.* 17 May 2013. Web. http://www.bbc.co.uk/news/world-middle-east-22557347
[87] Hilleary, Cecily. "What We Know About Chemical Weapons in Syria." *Voice of America.* 2 May 2013. Web. http://www.voanews.com/content/what-we-know-about-chemical-weapons-in-syria/1653286.html

chemical materials enclosed in a rocket at Khan al-Assal.[88] Sana later released photographs of the suspected corpses, though none showed "obvious signs of exposure to chemical weapons".

Dr. Zaher Sahloul, president of the Syrian-American Medical Association, conversely stated that the patients he saw in Khan al-Assal had symptoms "consistent with cholinergic syndrome". This syndrome is a common effect of "exposure to nerve gas."

Further describing their symptoms, Sahloul noted that "the patients had respiratory and neurologic symptoms—respiratory, including shortness of breath, bronchospasm, a lot of secretion and respiratory failure requiring mechanical ventilation, large concentration oxygen—and also neurologic symptoms, confusion, convulsions, and some of them went into comas—and also eye symptoms."[89]

After the attack, doctors related to the Syrian American Medical Society took blood samples from the scene, and attempted to have them inspected outside of Syria's borders. Following contact between a U.S. based Syrian doctor and another doctor in Aleppo, blood samples were taken to the Reyhanli in Turkey. Prior to their arrival, the U.S. government was informed.

A day or two following the samples' arrival in Reyhanli, the White House noted that their were strong signs and "some degree of varying confidence" that Syrian government forces had utilized sarin gas in combat.[90]

Allegations over the perpetrators of the attack continue. On July 9th, 2013, the Russian government accused Syria opposition forces of firing a sarin-filled projectile into the town. Russia asserted that the projectile was a "Bashair-3 unguided projectile" fired by an affiliate of the Free Syrian Army, entitled the Bashair al-Nasr brigade. These allegations followed a UN declaration that "limited quantities of toxic chemicals" had indeed been utilized in Khan al-

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[88] "Syria chemical weapons allegations."
[89] Hilleary, Cecily.
[90] Fahim, Kharim. "Still More Questions Than Answers on Nerve Gas in Syria." *NYTimes.* 11 June 2013. Web. http://www.nytimes.com/2013/06/11/world/middleeast/still-more-questions-than-answers-on-nerve-gas-in-syria.html?pagewanted=all

Assal, but that it had been impossible to identify the perpetrators of the attack[91].

In response, the opposition Syrian National Coalition denied the claims, and reaffirmed the necessity for U.N. investigators to be allowed access to the town[92].

March 19th- Al-Otaybeh

On March 19th, the same days as the Khan al-Assal attacks, Syrian activists uploaded video clips of victims of the alleged bombardment of Al-Otaybeh. The bombardment reportedly utilized chemical weapons, with victims shown struggling to breathe.

One of the videos features an interview with a local doctor, who suggests that his patients have suffered due to exposure from an organophosphate chemical. He notes that he is treating one of the men with atropine, a remedy for exposure to nerve agents.

Douma officials, a neighboring town, have stated that they have conserved six corpses linked to chemical weapons attacks, with some having died in Al-Otaybeh.[93]

March 24th- Adra

In its March 24th review, the Local Co-ordination Committees, a group of Syrian activists, stated that dozens had been wounded and at least two killed when Adra was attacked with "chemical phosphorous bombs."

Those injured in the attacks were reported as suffering from muscular cramping, and respiratory issues. A video that featured on The Shaam News Network showed further symptoms including "convulsions, excess saliva, narrow pupils and vomiting."[94]

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[91] BBC. "Russia Claims Syria Rebels Used Sarin at Khan al-Assal" http://www.bbc.co.uk/news/world-middle-east-23249104
[92] Charbonneau, Louis. "Syria Opposition Denies Russian Chemical Attack Allegation", *Reuters* http://www.reuters.com/article/2013/07/10/us-syria-crisis-chemical-opposition-idUSBRE9690JL20130710
[93] "Syria chemical weapons allegations."
[94] "Syria chemical weapons allegations."

Opposition forces claim that the bombs were fired by Syrian army rocket launchers at rebels near an Adra military base[95].

April 13th- Sheikh Maqsoud, Aleppo

On April 13th, the Syrian Observatory for Human Rights (SOHR) reported that two women and two children had been killed due to exposure to "gases from bombs dropped by an aircraft on the Sheikh Maqsoud neighborhood." Online footage allegedly showed victims "frothing at the mouth and twitching, both symptoms of exposure to nerve gas."[96] Twelve more people were injured, which a majority of them succumbing to illness following exposure to the original victims of the attack.[97]

The final death toll of the attack states that 31 people were killed, including 10 soldiers, and wounded scores more.[98] United Nations investigators in Geneva also reported on the same day that they had found "reasonable grounds to believe limited quantities of toxic chemicals were used" in Aleppo.[99] The U.N. reported that "reasonable grounds to believe limited quantities of toxic chemicals were used" existed, regarding attacks in Aleppo, Damascus, and Idlib.[100]

April 29th- Saraqeb

On-ground reports following the April 29th Saraqeb attacks suggest that government forces shelled the city and used a helicopter to drop at least two containers believed to have contained poisonous gases. Local hospital workers stated that eight people had suffered respiratory problems, while other symptoms included miosis and vomiting[101]. Laboratories in Turkey, the UK, and France are all carrying out examinations on Saraqeb samples.

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95 Charbonneau, Louis. "UK Says Informed U.N. of more Syria Chemical Attacks". *Reuters*
96 "Syria chemical weapons allegations."
97 "Syria's chemical weapons stockpile and human impact."
98 Baker, Aryn.
99 Fahim, Kharim.
100 Cumming-Bruce, Nick, and Seven Erlanger. "France Offers Evidence of 'Multiple' Uses of Nerve Gas in Syria." *New York Times.* 4 June 2013. Web. http://www.nytimes.com/2013/06/05/world/middleeast/france-offers-evidence-of-multiple-uses-of-nerve-gas-in-syria.html?pagewanted=all
101 Pannell, Ian. "Syria Crisis: 'Strong Evidence' of Chemical Attacks, in Saraqeb". *BBC* http://www.bbc.co.uk/news/world-middle-east-22551892

One woman died following the attack, with her reported symptoms linking her death to organophosphate poisoning.

The recovered containers were described as “box-like with a hollow concrete casing inside.” An alleged on-scene video showed what appeared to be white powder surrounding one of the devices.

A former officer at the Joint Chemical Biological Radiological Nuclear Regiment located in the UK entitled Hamish de Bretton-Gordon stated that the evidence coming out of Saraqeb was "strong, albeit incomplete.” He noted that in three comparable events around Syria, as well Saraqeb itself, "people have got ill and died and their symptoms are what we would expect to see from a nerve type of agent, be it sarin or be it organophosphate.” He further states that similar conclusions could be drawn to the events in al-Otaybeh, Adra, and Sheikh Maqsoud.[102]

Notably, the French Foreign Minister Laurent Fabius stated that recovered samples of the Sarqib victims had tested positive for Sarin, which left him “no doubt” that government forces were responsible for the gas attacks.[103]

Conclusion

In Assad’s multiple uses of chemical weapons against his own citizens in Syria, it reflects the dangerous switch in mentality of the Syrian regime. Syrian perspective now views chemical and biological weapons use as ‘conventional’ instead of categorizing these weapons as special under ‘non-conventional’. This shift in thinking has allowed the Syrian regime to use these weapons and induce a new means of offensive warfare. It is critical to continue to keep track and watch the movements of Syrian government and opposition forces in order to see which areas they convey and inadvertently which arsenals of chemical weapons they control. More importantly, it is critical to track the use and location of these chemical weapons to ensure that they do not get into the black market or the hands of terrorist organizations, which could have very potent consequences.

[102] Panell, Ian.
[103] Fahim, Kharim.