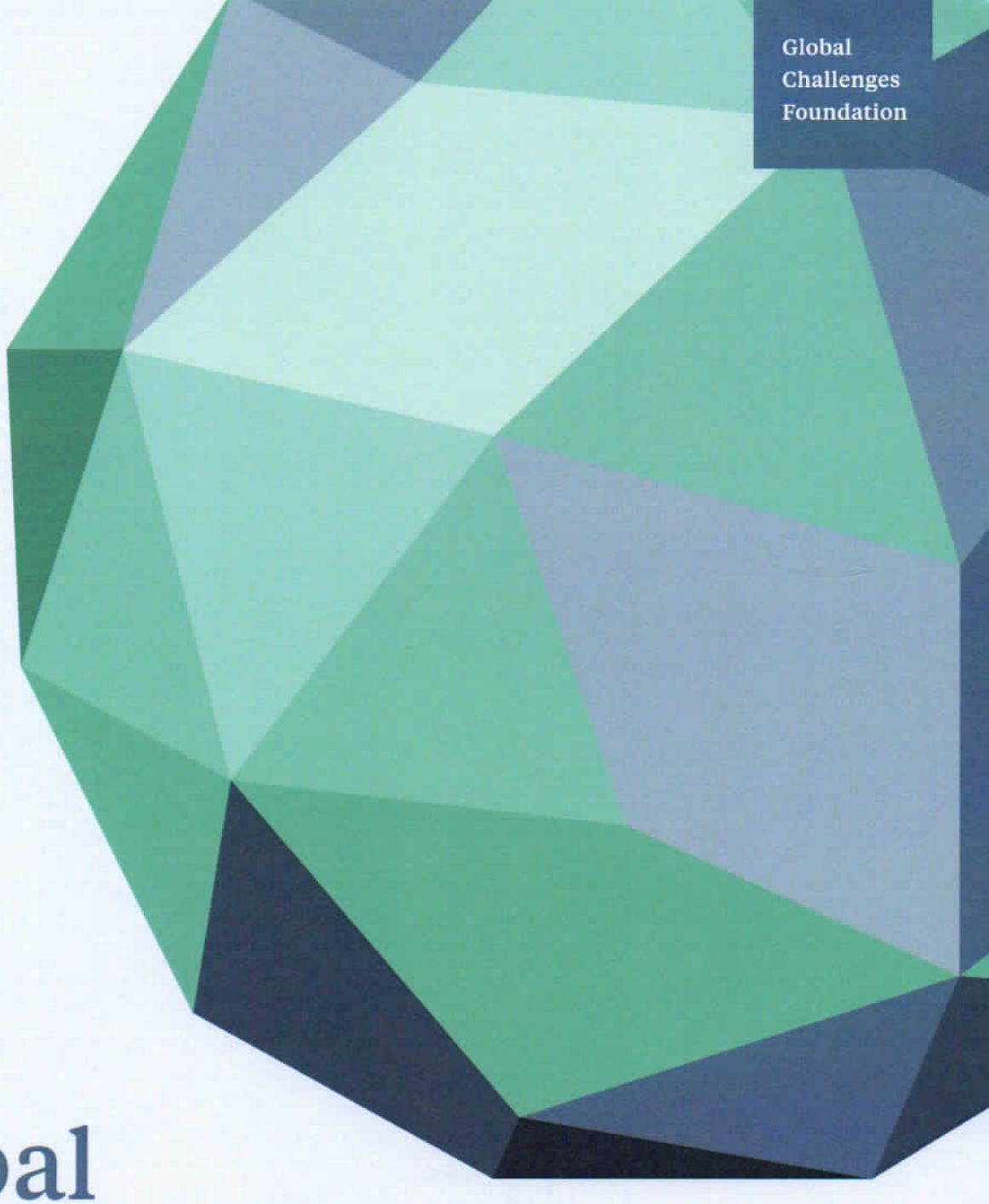

Global
Challenges
Foundation

Global Catastrophic Risks 2018

THE GLOBAL CHALLENGES FOUNDATION works to incite deeper understanding of the global risks that threaten humanity and catalyse ideas to tackle them. Rooted in a scientific analysis of risk, the Foundation brings together the brightest minds from academia, politics, business and civil society to forge transformative approaches to secure a better future for all.

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CENTRE FOR THE STUDY OF EXISTENTIAL RISK
UNIVERSITY OF CAMBRIDGE

Bulletin of the Atomic Scientists

IT IS TWO AND A HALF MINUTES TO MIDNIGHT*

University of BRISTOL

Contents

PROBABILITY OVER TIME

When we hear that the probability of a global nuclear war is estimated to be no more than 1%, 0.1% or 0.01% every year, this may sound reassuringly low – but how does this compound over time? Let's imagine that you flip a coin exactly once every year. What is the probability that no single coin flip will fall on heads in a certain amount of years? Over the course of one year the probability is 50%. Over two years, it goes down to 25%, 12.5% over three years, 6.25% over four years, and so on along an exponential curve. Using the same logic, if there was a 99.9% probability that we won't have a global nuclear war in a given year, this number goes down along a similar exponential curve to just above 99% over the course of a decade, and about 90.5% over a century – or a 9.5% probability that a global nuclear war would occur.

However, two elements challenge this purely logical model. First, the reasoning presupposes that probability remains stable over time, which is empirically unlikely. In the case of nuclear war, for instance, the absence of any incident might increase the sense of safety, leading to relaxed security measures, and a greater probability that an incident would occur. Second, risk estimates are often contentious to start with, and our understanding of interconnected causal chains decreases over time. This is why probabilities are typically given as a bracket rather than a single number – acknowledging that all predictions about the future include margins of uncertainty but that we can, nonetheless, produce educated estimates.

Today's more powerful nuclear weapons will cause up to

95%

fatalities within a radius of 1 to 4 km from their point of detonation, and very severe damage for up to six times as far.

CLOSE CALLS

The most dangerous nuclear war scenarios may be those resulting from an accident or misperception. Close calls have occurred a number of times since 1945.

During the Cuban missile crisis, in **October 1962**, the United States targeted a Soviet submarine that carried nuclear weapons. Two of the three Soviet officers wanted to launch nuclear weapons in response. The procedures required agreement between all three. Vasili Arkhipov, the third officer, refused, potentially averting nuclear war.

In **September 1983**, a Soviet satellite detected five missiles directed at the Soviet Union. The officer on duty, Stanislav Petrov, had minutes to decide whether this was a false alarm. Procedure would have required him to alert his superiors but, on gut instinct, he reported the incident as a false alarm. Investigations later revealed that reflections of the sun on the top of clouds had been mistaken for nuclear rockets.

On **January 25, 1995**, Russian radar detected a scientific weather rocket over the northern coast of Norway. Operators suspected it was a nuclear missile. President Yeltsin reportedly faced the decision to launch nuclear weapons in retaliation. He decided not to, guessing – correctly – that the rocket was not an actual attack.

Similar close calls in the future have the potential to trigger a global nuclear war[19].

Reviewed by
ANGELA KANE

Biological and chemical warfare

HOW MUCH DO WE KNOW?

Unlike nuclear weapons, which require rare materials and complex engineering, biological and chemical weapons can be developed at a comparatively low cost[20], placing them within the reach of most or all states as well as organized non-state actors. Chemical and biological weapons carry various levels of risk. Toxic chemicals could be aerosolized or placed into water supplies, eventually contaminating an entire region. Biological weapons possess greater catastrophic potential, as released pathogens might spread worldwide, and cause a pandemic.

Recent developments in synthetic biology and genetic engineering are of particular concern[21]. The normal evolution of most highly lethal pathogens ensures that they will fail to spread far before killing their host. Technology, however, has the potential to break this correlation, and create both highly lethal and highly infectious agents[22]. Such pathogens could be released accidentally from a lab, or intentionally released in large population centres[23]. Current trends towards more open knowledge sharing can both contribute to and mitigate such risks.

Unlike nuclear weapons, which require rare materials and complex engineering, biological and chemical weapons can be developed at a comparatively low cost.

WHAT ARE KEY FACTORS AFFECTING RISK LEVELS?

- **Global frameworks** controlling research on chemical or biological weapons including revised strategic trade controls on potentially sensitive dual-purpose goods, technology and materials, biological and chemical safety and security measures, as well as an ongoing commitment and capacity to enforce disarmament and arms control conventions[24].
- **The number of laboratories** researching potential pandemic pathogens for military or civilian purposes, and the public availability of dangerous information circulating for scientific purposes, increase the level of risk[25].
- **Further developments** in synthetic biology and genetic engineering lowering skill levels and costs to modify existing pathogens or to develop new pathogens which, in turn, may significantly increase biological risks to society[26].

CHEMICAL WEAPONS: AN UNRAVELLING CONSENSUS?

Deadly agents like sulphur mustard were used during and between the World Wars, but the horrific results of such attacks eventually led to a global consensus to ban toxic chemical weapons, the most widely-used and easily proliferated weapon of mass destruction[27].

This consensus, however, represented by the near-universal 1993 Chemical Weapons Convention (CWC) is under strain. The Syrian Civil War has resulted in well-documented and indiscriminate uses of various deadly toxic chemicals against the civilian population, most recently in Khan Sheikhoun on 4 April[28]. **The Khan Sheikhoun attack resulted in at least 85 victims – including some 20 children – dying from the deadly nerve agent Sarin (or 'sarin-like' compound).** Though the risk may always exist from easily available dual-use chemicals, and from terrorists like the Aum Shinrikyo, which perpetrated the Tokyo attack in 1995, there is a global risk that the hard-won consensus on banning state-use of toxic chemicals will be further weakened[29]. This could lead to the devastating return of more advanced toxic chemical weapons of mass destruction in any potential large-scale conflict in the future, as well as long-term changes in how states understand the development, evaluation and use of 'non-standard chemical substances' (substances other than deadly substances like sarin) for domestic riot control purposes, counter-terrorism operations, international peacekeeping operations, and as a mechanism to maintain a standby offensive chemical weapons capability.

RECENT USAGE

Though their production and use is banned by International conventions, biological and chemical weapons have been used at least on four occasions in the last forty years, three times in war, and once in an act of terrorism:

Rhodesia, late 1970s: cholera, anthrax, epidemic typhus and typhoid fever pathogens were released in water supplies used by guerillas.

Iraq-Iran, 1980-1988: mustard gas used in trench warfare killed 20,000 and affected 100,000. In March 1988, poison gas killed between 3,200 to 5,000 people in Halabja and injured 7,000 to 10,000 more. Thousands have since died prematurely of the after-effects. Others continue to receive medical treatment and/or remain under periodic medical observation and care.

Japan, March 1995: Sarin gas released on trains in Tokyo by the Aum Shinrikyo cult killed 12 people, and severely injured 50.

Syria, 2012 – 2017: Sarin and chlorine gas attacks have been recurring and are still ongoing. The most lethal attack killed 837 people in August 2013, another killed up to 100 on April 2017[30].