# Notes

### overview

The focus of this file – because of arguments at the workshop, is on biotech. We included AI as well to provide a model of what a file might look like when you get back home for the season versus AI teams. Neither of those sections reflect the full impact/impact turn debate in the lit – but does give you a sampling.

Remember that you can access terminal impact back up and defense in other files if the cards in this file don’t seem sufficient

### Why not cyber?

Cyber is a bit trickier – few people argue that cyber attacks are good outside of a very specific context [ie people do praise Ukrainian cyber defenders who hacked Russia at start of invasion].

There are cyber offense good in the cyber aff files; however, none of them really say that defense trades off with offense – but 1-2 cards to this end would allow you to construct a cyber focus tradeoff argument, with cyber offense as a net benefit

# AI Development Now

## AI development now – general

### 1nc/2ac

#### R&D into AI developing core AI capabilities now

**Baidu, Chinese multinational technology company specializing in Internet-related services and products and artificial intelligence, 2021**

[Baidu, “These five AI developments will shape 2021 and beyond”, MIT Technology Review, January 14, 2021, <https://www.technologyreview.com/2021/01/14/1016122/these-five-ai-developments-will-shape-2021-and-beyond/#:~:text=AI%20hardware%20continued%20to%20develop,for%20tasks%20like%20deep%20learning>., accessed July 6, 2022, GDI-LL]

The year 2020 was profoundly challenging for citizens, companies, and governments around the world. As covid-19 spread, requiring far-reaching health and safety restrictions, artificial intelligence (AI) applications played a crucial role in saving lives and fostering economic resilience. Research and development (R&D) to enhance core AI capabilities, from autonomous driving and natural language processing to quantum computing, continued unabated. Baidu was at the forefront of many important AI breakthroughs in 2020. This article outlines five significant advances with implications for combating covid-19 as well as transforming the future of our economies and society.

## AI inevitable – science and computing innovation

### Quantum computing

#### Quantum mechanics inroads prove development of more advanced AI is inevitable

**Baidu, Chinese multinational technology company specializing in Internet-related services and products and artificial intelligence, 2021**

[Baidu, “These five AI developments will shape 2021 and beyond”, MIT Technology Review, January 14, 2021, <https://www.technologyreview.com/2021/01/14/1016122/these-five-ai-developments-will-shape-2021-and-beyond/#:~:text=AI%20hardware%20continued%20to%20develop,for%20tasks%20like%20deep%20learning>., accessed July 6, 2022, GDI-LL]

4. Quantum computing The trend—and why it matters. Quantum computing made significant inroads in 2020, including the Jiuzhang computer’s achievement of quantum supremacy. This carries significance for AI, since quantum computing has the potential to supercharge AI applications compared to binary-based classical computers. For example, quantum computing could be used to run a generative machine learning model through a larger dataset than a classical computer can process, thus making the model more accurate and useful in real-world settings. Advanced technologies such as deep learning algorithms are also playing an increasingly critical role in the development of quantum computing research. Baidu’s innovations. Baidu achieved a number of technical breakthroughs in 2020 that promise to bridge AI and quantum computing. In May, Baidu launched Paddle Quantum, a quantum machine learning development toolkit that can help scientists and developers quickly build and train quantum neural network models and provide advanced quantum computing applications. The open-source toolkit both supports developers building quantum AI applications, and helps deep learning enthusiasts develop quantum computing. In September, Baidu entered cloud-based quantum computing with the launch of Quantum Leaf, which provides quantum development kits such as QCompute, and can shorten the life cycle of quantum programming and help realize a ‘closed-loop’ quantum tool chain.

## AI investment now – government investment

### 1nc/2ac

#### Federal spending on AI up across agencies – including those without scientific mission

**Wiggers, writes about artificial intelligence for VentureBeat, 2021**

[Kyle, “AI Weekly: U.S. agencies are increasing their AI investments”, Venture Beat, September 11, 2021, <https://venturebeat.com/2021/09/11/ai-weekly-u-s-agencies-are-increasing-their-investments-in-ai/>, accessed July 7, 2022, GDI-LL]

This week, the U.S. Department of Commerce announced that it’ll form a committee to advise federal agencies on AI research and developments. Called the National Artificial Intelligence Advisory Committee and supported by the National Institute of Standards and Technology and the White House’s National AI Initiative Office, it’ll focus on a range of issues related to AI, including the current state of U.S. competitiveness and how AI can enhance opportunities for different geographic regions. The committee’s formation comes as federal spending on AI technologies ramps up during the pandemic. According to Deltek, identifiable federal spending on AI rose to nearly $1 billion in 2020, making it one of the fastest-growing emerging tech investment areas. While that figure fell short of estimates — Bloomberg Government projected that the U.S. would pour over $6 billion in AI-related R&D projects in 2021 — it’s a sign of renewed enthusiasm from the government in backing technologies that could yield $13 trillion in economic benefits by 2030. Former Google CEO Eric Schmidt is among those who’ve urged lawmakers to bolster funding in the AI space while incentivizing public-private partnerships to develop AI applications across government agencies. The National Security Commission on Artificial Intelligence estimates the U.S. needs to spend $32 billion over the next few years to win the AI race with China, among other rivals. To achieve this, President Joe Biden has proposed spending 2% of the U.S.’s total economic output — or GDP — on science, up from around 0.7%. That would equate to roughly $418 billion at last year’s GDP level, up from about $146 billion. The report shows that the federal government isn’t close to approaching Biden’s target. But it reveals that AI spending across agencies is on the rise generally, up 50% compared with 2018. Moreover, U.S. AI spending is growing at agencies even without a primarily scientific mission, the report reveals — such as the Departments of Justice, Transportation, and State. And AI capabilities including robotic process automation are increasingly being used by the government for research, surveillance, trend analysis, and vaccine development.

### Extension – government spending increasing

#### Federal funds for R&D into AI expanding – multiple agencies prove

**Wiggers, writes about artificial intelligence for VentureBeat, 2021**

[Kyle, “AI Weekly: U.S. agencies are increasing their AI investments”, Venture Beat, September 11, 2021, <https://venturebeat.com/2021/09/11/ai-weekly-u-s-agencies-are-increasing-their-investments-in-ai/>, accessed July 7, 2022, GDI-LL]

\*R&D – Research and Development

Between 2018 and 2020, U.S. government agencies spent a total of $1.9 billion in AI-related service obligations, representing a 70% increase over the three-year period. R&D spending reached $1.2 billion over the same 2018-to-2020 timeframe, despite the fact that AI spend from the Department of Transportation, Department of Homeland Security (DHS), and the National Aeronautics and Space Administration decreased by a combined $81 million.

Agencies with substantial AI spending outside the top ten included the Department of Veterans Affairs ($38 million), the Department of Commerce ($37 million), the Department of Agriculture ($28 million) and the Social Security Administration ($26 million). Spending on autonomy across all agencies totaled $520 million from 2018 to 2020, followed by intelligent systems ($122 million), machine learning ($114 million), augmented reality ($39 million), deep learning ($26 million), and virtual reality ($24 million).

## AI investment now – private investment

### 1nc/2ac

#### Private AI investment growing – venture capitalists and other investments increase sector growth currently outpaces China

**Digital Signage, computer related news outlet, 2022**

[Digital Signage Today, “Private investment in artificial intelligence $93.5B in 2021”, Digital Signage Today, May 13, 2022, <https://www.digitalsignagetoday.com/news/private-investment-in-artificial-intelligence-935b-in-2021/#:~:text=Economic%20investment%20in%20artificial%20intelligence,what%20it%20was%20in%202020>., accessed July 7, 2022, GDI-LL]

Economic investment in artificial intelligence technology continues to rise. A moneytransfers.com analysis shows that private investment in AI in 2021 was $93.5 billion — more than double what it was in 2020.

The total amount of funding raised by venture capitalists for AI startups has increased significantly since 2017. However, the number of companies qualifying for funding is shrinking.

The AI sector's value will exceed the $135 billion mark in 2022, growing at a combined annual growth rate of 38% between now and 2030, according to analysts. This increase can be attributed to improved performance by algorithms, increased use cases for AI products and services and an influx of startups into the market.

The U.S and China lead in private investments in the field. Though the U.S. currently holds an upper hand, China has been rapidly gaining ground following significant investments in AI. By the end of 2020, the U.S had invested over $23 billion in private investments in the sector. That was more than twice the $9.9 billion that China did. However, China has set its sights on becoming the world's AI innovation hub, targeting to grow its market share to $150 billion.

### Extension – business incentives

#### AI enhances business performance and profits – incentivize development

**Baidu, Chinese multinational technology company specializing in Internet-related services and products and artificial intelligence, 2021**

[Baidu, “These five AI developments will shape 2021 and beyond”, MIT Technology Review, January 14, 2021, <https://www.technologyreview.com/2021/01/14/1016122/these-five-ai-developments-will-shape-2021-and-beyond/#:~:text=AI%20hardware%20continued%20to%20develop,for%20tasks%20like%20deep%20learning>., accessed July 6, 2022, GDI-LL]

5. AI chips

The trend—and why it matters. AI hardware continued to develop in 2020, with the launch of several AI chips customized for specialized tasks. While an ordinary processor is capable of supporting AI tasks, AI-specific processors are modified with particular systems that can optimize performance for tasks like deep learning. As AI applications become more widespread, any increase in performance or reduction in cost can unlock more value for companies that operate a wide network of data centers for commercial cloud services, and can facilitate the company’s internal operations.

Baidu’s innovations. At Baidu World 2020, the company offered a glimpse into its next-generation AI processor, the Kunlun 2, which it plans to put into mass production in early 2021. The chip uses 7 nanometer (nm) processing technology and its maximum computational capability is over three times that of the previous generation, the Kunlun 1. The Kunlun chips are characterized by high performance, low cost, and high flexibility, which can support a broad range of AI applications and scenarios, helping foster greater AI adoption and reducing usage costs. More than 20,000 Kunlun 1 chips have now been deployed to support Baidu’s search engine and Baidu Cloud partners since they launched in 2018, empowering industrial manufacturing, smart cities, smart transportation, and other fields.

# AI Good/not so bad – Impact Debate

## AI Good – Laundry list

### 1nc/2ac

#### AI provides laundry list of benefits

**CSU Global, 21**

["Why is AI Important?", CSU Global, 7/5/21, https://csuglobal.edu/blog/why-ai-important, accessed 7/6/22, GDI-cc]

Artificial intelligence technology offers several critical benefits that make it an excellent tool for virtually any modern organization, including:

Automation - AI is able to automate a repetitive task that was previously done manually, without feeling any fatigue or having to take breaks like a human employee would need to do.

Enhancement - AI can make products and services smarter and more effective, improving experiences for end-users, via capabilities like optimizing conversation bots or customer service menus, and delivering better product recommendations.

Analysis - AI can analyze data at a much faster rate than humans, allowing it to find patterns much more quickly, and it can also analyze much larger datasets than humans, allowing it to uncover patterns humans would simply miss.

Accuracy - AI can be trained to become more accurate than humans, utilizingits ability to harvest and interpret data to come up with better decisions for tasks like picking financial investments or identifying cancerous growths on x-rays.

ROI - AI maximizes the value of data since it’s able to do a better job analyzing complex, multi-variate relationships, without having to take any breaks and with fewer mistakes, making it an incredibly important technology for any business that relies on data and operates at scale.

Simply put, AI allows organizations to make better decisions, improving core business processes by increasing both the speed and accuracy of strategic decision-making processes.

The reason there’s so much talk about how AI could revolutionize the world and change the future is that AI solutions are already being applied in virtually every industry, with excellent results.

Here’s just a handful of specific applications where artificial intelligence has proven to be incredibly effective:

Healthcare - AI applications are being used to deliver personalized medicine, providing patients with reminders about when to take their medicine, and suggestions about which specific exercises they should perform.

Retail - AI technology is applied in retail environments to handle stock management, design more effective store layouts, and provide personalized shopping recommendations via Amazon’s “You May Also Like” suggestions, as well as personalized viewing suggestions via Netflix’s machine learning-driven recommendation algorithm.

Manufacturing - AI solutions are used to forecast load and demand for factories, ensuring they’re run as efficiently as possible by helping to make better decisions about logistics and planning for materials ordering, timetables to project completion, etc.

Banking - AI systems are being used to review financial transactions to detect fraudulent activity, assess credit scores with greater accuracy, and automate tasks requiring manual data input and data management.

Life Sciences - AI technology is being applied to test new medicines, allowing organizations to bring them to market sooner, and to analyze large and complex data sets that help discover new, more effective therapies and pharmaceutical drugs.

Clearly, AI has already been applied to a whole host of important processes, but there are hundreds or even thousands of additional applications for virtually every sector of the modern economy.

What makes AI such a game-changing technology? The fact that it can perform similar tasks as human beings, but faster, and with fewer mistakes.

## AI Good – Clean Energy

### 1nc/2ac

#### AI creates an effective energy transition – intelligent coordination layer helps energy-system personnel identify patterns in data and improve energy systems over time

**Mehlum et al, 21**

[Espen, Head of Energy, Materials & Infrastructure ath the World Economic Forum, "This is how AI will accelerate the energy transition", World Economic Forum, 9/1/21, https://www.weforum.org/agenda/2021/09/this-is-how-ai-will-accelerate-the-energy-transition/, accessed 7/6/22, GDI-cc]

Three key trends are driving AI’s potential to accelerate energy transition:

1. Energy-intensive sectors including power, transport, heavy industry and buildings are at the beginning of historic decarbonization processes, driven by growing government and consumer demand for rapid reductions in CO2 emissions. The scale of these transitions is huge: [BloombergNEF estimates](https://about.bnef.com/new-energy-outlook/) that in the energy sector alone, achieving net-zero emissions will require between $92 trillion and $173 trillion of infrastructure investments by 2050. Even small gains in flexibility, efficiency or capacity in clean energy and low-carbon industry can therefore lead to trillions in value and savings.

2. As electricity supplies more sectors and applications, the power sector is becoming the core pillar of the global energy supply. Ramping up renewable energy deployment to decarbonize the globally expanding power sector will mean more power is supplied by intermittent sources (such as solar and wind), creating new demand for forecasting, coordination, and flexible consumption to ensure that power grids can be operated safely and reliably.

3. The transition to low-carbon energy systems is driving the rapid growth of distributed power generation, distributed storage and advanced demand-response capabilities, which need to be orchestrated and integrated through more networked, transactional power grids.

Navigating these trends presents huge strategic and operational challenges to the energy system and to energy-intensive industries. This is where AI comes in: by creating an intelligent coordination layer across the generation, transmission and use of energy, AI can help energy-system stakeholders identify patterns and insights in data, learn from experience and improve system performance over time, and predict and model possible outcomes of complex, multivariate situations.

AI is already [proving its value](https://www.ifc.org/wps/wcm/connect/bd3a196d-a88f-45af-bbc6-e0b00790fba8/EMCompass_Note_81-05-web.pdf?MOD=AJPERES&CVID=n72pj5g) to the energy transition in multiple domains, driving measurable improvements in [renewable energy forecasting](https://www.ey.com/en_us/power-utilities/why-artificial-intelligence-is-a-game-changer-for-renewable-energy), [grid operations and optimization](https://www.pv-magazine.com/2021/08/13/ai-powered-bidding-platform-for-australias-biggest-solar-farm/), [coordination of distributed energy assets and demand-side management](https://www.irena.org/-/media/Files/IRENA/Agency/Topics/Innovation-and-Technology/IRENA_Landscape_Solution_07.pdf?la=en&hash=57385C8E232455C58F845598879A9B8BFF55373B), and [materials innovation and discovery](https://www.energy.gov/sites/prod/files/2018/12/f58/Moving%20Applications%20of%20AI%20and%20ML%20from%20Materials%20Design%20Discovery%20thru%20Process%20Design%20Development_B%20Valentine.pdf). But while AI’s application in the energy sector has proven promising so far, innovation and adoption remain limited. That presents a tremendous opportunity to accelerate transition towards the zero-emission, highly efficient and interconnected energy system we need tomorrow.

### Extensions - AI – wind and solar reliability

#### AI improves reliability of clean energy by analyzing data and making predictions to improve the energy transition solar and wind specific

**Makala and Bakovic, 20**

[Baloko, consultant at Thought Leadership in the Department of Economics at IFC, and Tonci, Chief Energy Specialist at IFC, "Artificial Intelligence in the Power Sector", IFC, 4/13/20, https://www.ifc.org/wps/wcm/connect/bd3a196d-a88f-45af-bbc6-e0b00790fba8/EMCompass\_Note\_81-05-web.pdf?MOD=AJPERES&CVID=n72pj5g, accessed 7/7/22, GDI-cc]

Excess solar or wind power is stored during low-demand times and used when energy demand is high. As a result, AI can improve reliability of solar and wind power by analyzing enormous amounts of meteorological data and using this information to make predictions and decisions about when to gather, store, and distribute wind or solar power. On the other hand, AI is also used in smart grids to help balance the grid. AI analyzes the grid before and after intermittent units are absorbed and learns from this to help reduce congestion and renewable energy curtailment.23

AI is also gaining ground in Latin America. Argentina has embarked on a modernization effort of its power grid infrastructure by investing in automation of power distribution, remote reading of energy meters across several cities, and the implementation of renewable energy generators. In Baja California, IFC is helping CENACE (Centro Nacional de Control de Energía) model the effect of cloud coverage on solar generation to help balance the grid with batteries. The AI algorithms developed help the ISO react in seconds to provide primary regulation to stabilize the grid. In much of Sub-Saharan Africa, access to home electricity remains a challenge. Africans spend as much as $17 billion a year on firewood and fuels such as kerosene to power primitive generators.24

There are glimmers of hope, however. Azuri Technologies developed a pay-as-yougo smart-solar solution used in East Africa and Nigeria. Azuri’s HomeSmart solution is built on AI. It learns home energy needs and adjusts power output accordingly—by automatically dimming lights, battery charging, and slowing fans, for example—to match the customer’s typical daily requirements. The company recently secured $26 million in private equity investment to expand its solutions across Africa.25

### Extensions AI – smart grid

#### AI-managed smart grids introduce new solutions for renewable energy – they enable communication and precise data

**Makala and Bakovic, 20**

[Baloko, consultant at Thought Leadership in the Department of Economics at IFC, and Tonci, Chief Energy Specialist at IFC, "Artificial Intelligence in the Power Sector", IFC, 4/13/20, https://www.ifc.org/wps/wcm/connect/bd3a196d-a88f-45af-bbc6-e0b00790fba8/EMCompass\_Note\_81-05-web.pdf?MOD=AJPERES&CVID=n72pj5g, accessed 7/7/22, GDI-cc]

The power sector has a promising future with the advent of solutions such as AI-managed smart grids. These are electrical grids that allow two-way communication between utilities and consumers.2 Smart grids are embedded with an information layer that allows communication between its various components so they can better respond to quick changes in energy demand or urgent situations. This information layer, created through widespread installation of smart meters and sensors, allows for data collection, storage, and analysis.3

Phasor measurement units (PMUs), or synchrophasors, are another essential element of the modern smart grid. They enable real-time measurement and alignment of data from multiple remote points across the grid. This creates a current, precise, and integrated view of the entire power system, facilitating better grid management.

Paired with powerful data analytics, these smart-grid elements have helped improve the reliability, security, and efficiency of electricity transmission and distribution networks.4,5 Given the large volume and diverse structures of such data, AI techniques such as machine learning are best suited for their analysis and use.6 This data analysis can be used for a variety of purposes, including fault detection, predictive maintenance, power quality monitoring, and renewable energy forecasting.7

Innovation in information and communications technologies (ICT), cloud computing, big-data analytics, and artificial intelligence have supported the proliferation of smart metering. The widespread use of smart meters and advanced sensor technology has created huge amounts of data that is generated rapidly. This data requires new methods for storage, transfer, and analysis. For illustration sake, with a sampling rate of four times per hour, one million smart meters installed in a smart grid would generate over 35 billion records.8

## AI Good – Carbon emissions

### 1nc/2ac

#### AI provides specific data at low costs and generates insights to improve climate resilience, facilitating decrease in carbon emissions

**Degot, 21**

[Charlotte, managing director at BCG GAMMA, Boston's consulting group's entity dedicaterd to data science, "How AI's full power can stimulate climate change action", World Economic Forum, 9/8/21, https://www.weforum.org/agenda/2021/09/time-to-utilise-the-full-power-of-ai-to-accelerate-our-fight-against-climate-change-301cb3f9d4/, accessed 7/6/22, GDI-cc]

AI can help measure and reduce emissions for any given institution

For a company to master its climate impact, it needs to take three steps: measure the baseline accurately, set targets, and act.

Too often, companies are blocked at the first step. The latest data from the CDP shows that only 31% of companies, which publicly disclose their emissions footprint, measure their impact exhaustively across all relevant categories (e.g., including supply chain emissions). As a result, companies struggle to move forward with meaningful targets and successful action plans.

Innovative AI-based solutions can enable companies to tackle the three steps in the same tool, empowering the full organization to make the best decisions regarding its climate impact. These kinds of comprehensive solutions, such as [BCG’s CO2 AI](https://www.bcg.com/en-cz/publications/2021/ai-to-reduce-carbon-emissions), create a 30% reduction in emissions. AI-based solutions are a clear step-change versus conventional manual approaches, enabling quick, reliable and granular baselining of the full emission footprint with greater accuracy.

Beyond that, powerful AI-based forecasts and simulations empower leaders to take the right choices to reduce emissions at scale and impactfully drive their climate journey. In the case of a large retail company, insights generated by BCG’s CO2 AI increased confidence in the achievability of a net zero target and helped accelerate the timeline to net zero by 10 years.

Another good example for AI-powered decisions that reduce emissions at scale is Google’s partnership with [electricityMap](https://www.electricitymap.org/map). By utilizing electricityMap – an AI-powered platform that shows in real-time how clean electricity is around the world and provides past, current and forecasted carbon footprint data for electricity by country – Google manages to align computing tasks with times of low-carbon electricity supply in the grid and, thus, reduces CO2e emissions from electricity consumption.

Finally, AI-based optimisation of process parameters helps identify untapped potentials to save both greenhouse gas emissions and cost. In the case of a global steel company, 10% of CO2e emissions and 1% of costs could be saved by employing state-of-the-art AI models to streamline carbon-intensive industrial operations.

AI can enable innovative business models to help the climate

Over the past years, global research has made strong progress in the development of innovative carbon abatement technologies, including: i) lower carbon fuels, ii) engineered carbon capture and storage, and iii) agricultural carbon sequestration.

Let’s take a deeper look into agricultural carbon sequestration to illustrate AI’s great potential to help advance this technology and deliver impact at scale.

First, smart AI-based algorithms can help identify the best-suited lands and soils in a very cost-efficient and scalable way, e.g., by learning from existing carbon sequestration action data and analysing vast agricultural, meteorological, and geological databases.

Second, AI can help perform large-scale carbon measurement in the soil at a low cost. Given the previously high cost of this measurement, AI is a major enabler for the financial model behind agricultural carbon sequestration.

Third, AI can be used with satellite imagery, for instance, to ensure that farmers comply with sowing practice changes committed to the people investing in the process and expecting to sell the CO2 certificates later. In total, AI will play an absolutely critical role to scale and deploy carbon sequestration with agriculture around the globe.

AI can improve resilience of our societies to climate hazards

As this summer’s weather catastrophes have proven across geographies, adapting our societies to climate change action is a major challenge. Again, AI can aid by helping manage the wide variety, diversity and volumes of data, and generating life-saving insights to improve resilience.

For instance, Google’s [“Hydronet” solution](https://ai.googleblog.com/2020/09/the-technology-behind-our-recent.html) can help identify the most critical vulnerabilities in the case of extreme river floods with unprecedented lead times and accuracy. As such, it is utilised to help improve flood forecasting in India and Bangladesh, covering more than 250 million people at risk.

## AI Good – health innovation

### 1nc/2ac

#### AI good for health innovation – it enhances medical imaging, collaboration, and data integration

**Rasooly, 22**

[Danielle, Research Associate in Medicine and graduate from Harvard University, "Artificial Intelligence in Medicine and Public Health: Prospects and Challenges Beyond the Pandemic", CDC, 3/1/22, https://blogs.cdc.gov/genomics/2022/03/01/artificial-intelligence-2/#:~:text=AI%20can%20also%20integrate%20multiple,the%20diagnosis%20of%20respiratory%20disorders., accessed 7/6/22, GDI-cc]

Though still in its infancy as a field, [artificial intelligence](https://www.nibib.nih.gov/science-education/science-topics/artificial-intelligence-ai) (AI) is poised to transform the practice of medicine and the delivery of healthcare. Powered by breakthroughs in [machine learning](https://www.nibib.nih.gov/science-education/science-topics/artificial-intelligence-ai) (ML) algorithms, enhanced computing power, and increasing data volume and storage capacity, AI has made noteworthy advances over the past decade across many medical subspecialties. [Experts predict](https://jamanetwork.com/journals/jama/article-abstract/2757958) AI-based medical devices and algorithms will play a major role in the delivery of preventive, diagnostic, and therapeutic interventions. In addition to our occasional blog on the topic (see recent [example](https://blogs.cdc.gov/genomics/2021/12/07/the-use-of-machine-learning/)), our Public Health Genomics and Precision Health Knowledge Base ([PHGKB](https://phgkb.cdc.gov/PHGKB/phgHome.action?action=home)) and our [weekly update](https://www.cdc.gov/genomics/update/current.htm) display the latest scientific literature, evidence synthesis, guidelines, evaluation, and implementation studies for the applications of AI in a wide variety of diseases across the lifespan.

A recent [Nature Medicine](https://www.nature.com/articles/s41591-021-01614-0) article discusses promising uses of artificial intelligence in medicine, particularly in medical imaging and big data integration, and considers technical and ethical challenges for their applications in improving human health. Here is a quick summary of the review and the implications for population health.

Imaging at the Forefront of AI in Medicine

In the interpretation of medical images — a niche where AI models have made great strides — the AI workflow starts with images that have been read and annotated by human experts. The AI model can analyze and interpret images and compare its interpretation to that of human experts. AI can then learn and refine its interpretation models over time and after analyzing numerous images. AI tools have shown that they can meet, or even exceed, experts’ performance across medical specialties that rely on human interpretation — namely, [radiology](https://www.nature.com/articles/s41591-019-0447-x), [pathology](https://www.nature.com/articles/s41586-021-03512-4), [dermatology](https://www.nature.com/articles/nature21056), [gastroenterology](https://www.nature.com/articles/s41467-020-16777-6), and [ophthalmology](https://jamanetwork.com/journals/jama/fullarticle/2588763/). For instance, [one study](https://www.nature.com/articles/s41591-019-0583-3) used AI methods to analyze whole-slide images and demonstrated that their model was more accurate in predicting patient survival from malignant mesothelioma, compared to current pathology practices. [Another study](https://www.nature.com/articles/s41467-020-16777-6#Abs1) demonstrated that an AI model for the optical diagnosis of colorectal cancer can achieve precision comparable to that of skilled endoscopists. Such advances have demonstrated how AI can refine diagnostic accuracy and improve patient outcome predictions, while enabling a faster clinical workflow and more efficient use of healthcare resources.

Many Promising Avenues for AI in Medicine

In addition to AI for medical image analysis, the review [paper](https://www.nature.com/articles/s41591-021-01614-0) presents three promising avenues for AI. First, AI can learn from non-image data sources, such as text and genome sequences, and can broaden the array of possible datasets that can be used for medical insights and drug discovery. AI methods have been used to predict outcomes from medical signal data, such as electroencephalograms (EEG), electrocardiograms, and audio data. For example, AI was [recently](https://pubmed.ncbi.nlm.nih.gov/31242361/) applied to EEG signals from clinically unresponsive patients with brain injuries to detect brain activity, an important predictor of long-term recovery.  AI can also integrate multiple sources of medical data for improved medical diagnosis. For example, one [study](https://pubmed.ncbi.nlm.nih.gov/31167662/) for diagnosing respiratory disorders took audio recordings of patients’ coughs as well as reports of their symptoms as input to enhance the diagnosis of respiratory disorders. AI models have also been applied to more complex inputs, such as electronic health records, with various data such as vital signs, prescriptions, and laboratory results.

Second, AI can learn from data without any labels or annotations (e.g. image labelled with a known medical diagnosis), a process known as unsupervised learning. Labeled data can often be costly and time-consuming to obtain. AI advancements that can use poorly labeled data can widen the landscape of applications in medicine. For example, clustering algorithms can organize unlabeled data points by grouping similar data points together have been applied to several conditions such as [sepsis](https://pubmed.ncbi.nlm.nih.gov/31104070/), [breast cancer](https://pubmed.ncbi.nlm.nih.gov/31959985/), and [endometriosis](https://pubmed.ncbi.nlm.nih.gov/32596513/) to identify clinically meaningful patient subgroups.

Finally, AI systems that collaborate with human experts can enable a symbiosis between AI and humans to harness the advantages of both and achieve performance that surpasses that of AI or human experts alone. For example, a recent [study](https://pubmed.ncbi.nlm.nih.gov/31714194/) found that AI-assisted experts surpassed both humans and AI alone when detecting malignancies on chest radiographs. The usefulness of human-AI collaboration will likely depend on specific tasks and clinical scenarios.

### Extension – vaccine development

#### AI can be used to rapidly develop vaccines – COVID vaccine development proves

**Baidu, hinese multinational technology company specializing in Internet-related services and products and artificial intelligence, 2021**

[Baidu, “These five AI developments will shape 2021 and beyond”, MIT Technology Review, January 14, 2021, <https://www.technologyreview.com/2021/01/14/1016122/these-five-ai-developments-will-shape-2021-and-beyond/#:~:text=AI%20hardware%20continued%20to%20develop,for%20tasks%20like%20deep%20learning>., accessed July 6, 2022, GDI-LL]

1. AI and vaccine development The trend—and why it matters. It typically takes years, if not decades, to develop a new vaccine. But by March 2020, vaccine candidates to fight covid-19 were already undergoing human tests, just three months after the first reported cases. The record speed of vaccine development was partly thanks to AI models that helped researchers analyze vast amounts of data about coronavirus. There are tens of thousands of subcomponents to the outer proteins of a virus. Machine learning models can sort through this blizzard of data and predict which subcomponents are the most immunogenic—i.e., capable of producing an immune response—and thereby guide researchers in designing targeted vaccines. The use of AI in vaccine development may revolutionize the way all vaccines are created in the future. Baidu’s innovations. In February, Baidu opened its LinearFold AI algorithm for scientific and medical teams working to fight the virus. LinearFold predicts the secondary structure of the ribonucleic acid (RNA) sequence of a virus—and does so significantly faster than traditional RNA folding algorithms. LinearFold was able to predict the secondary structure of the SARS-CoV-2 RNA sequence in only 27 seconds, 120 times faster than other methods. This is significant, because the key breakthrough of covid-19 vaccines has been the development of messenger RNA (mRNA) vaccines. Instead of conventional approaches, which insert a small portion of a virus to trigger a human immune response, mRNA teaches cells how to make a protein that can prompt an immune response, which greatly shortens the time span involved in development and approval. To support mRNA vaccine development, Baidu later developed and released an AI algorithm for optimizing mRNA sequence design called LinearDesign, which aims to solve the problem of unstable and unproductive mRNA sequences in candidate vaccines. In addition to opening up access to LinearFold and LinearDesign for researchers around the world, Baidu also formed a strategic partnership with the National Institute for Viral Disease Control and Prevention, part of the Chinese Center for Disease Control and Prevention. Following an outbreak at Beijing’s Xinfadi market in June, Baidu’s AI technology allowed authorities to complete genome sequencing of the coronavirus strain within 10 hours, helping curb the outbreak. In December, Baidu unveiled PaddleHelix, a machine learning-based bio-computing framework aimed at facilitating the development of vaccine design, drug discovery, and precision medicine.

### Extension - AI – lung cancer

#### AI good for lung cancer innovations – different algorithms offer unique learning abilities to solve this disease

**Chiu, 22**

[Hwa- Yen, doctor in the department of chest medicine at the Taipei General Hospital, "Application of Artificial Intelligence in Lung Cancer", MDPI, Vol. 14, Issue 6, 2022, ProQuest, accessed 7/6/22, GDI-cc]

In the 21st century, human life has been largely integrated with AI, and this trend also extends to the medical field. The heterogeneity of lung cancer makes it the best field for AI application. A large number of studies have reported the application in lung nodule detection, diagnostic application in histopathology, disease risk stratification, drug development, and even prognosis prediction. In this article, we present a narrative review of AI applications in lung cancer by introducing AI models first and then reported applications according to the clinical workflow: screening, diagnosis, decision making, and prognosis prediction. Table 1 listed the potential AI application fields in lung cancer.

2. AI Models

Numerous AI models are constructed with different algorithms are published nowadays. Generally, the AI models can be divided into: supervised learning, unsupervised learning, semi-supervised learning [9], and reinforcement learning (Figure 2).

2.1. Supervised Learning

In supervised learning, researchers need to prepare the labeled dataset with both inputs and desired outputs (answers) to train the algorithm. It is suitable to solve prediction problems, such as classification and regression. The architecture of the algorithms varies. Researchers can use multiple binary nodes to create DTs as a classifier, or find a plane in a multidimensional space as a SVM classifier. Bayesian classifiers used input data to calculate the probability of correct classification. With the probability calculated from the above-mentioned algorithm, researchers can turn the answer into a continuous variable to solve regression problems and vice versa. Most AI applications predicting survival [13,59], cancer risk [34,35,36,37,38,39], nodule detection [22,23], and nodule characteristics [33] are based on supervised learning.

2.2. Unsupervised Learning

In unsupervised learning, the algorithm divides the samples according to the inputs by itself. Labeled data are not necessary. It is suitable to do clustering, to find associations between samples, and to do dimensionality reduction. For example, cluster analysis was used to find oncogenes in lung cancer [67,68].

2.3. Semi-Supervised Learning

Though supervised learning provides a more accurate algorithm, the labeled data are relatively rare, and the labeling process is labor intensive. Unsupervised learning can adopt unlabeled data but the algorithm is less accurate. Therefore, semi-supervised learning could have both of the advantages when using supervised learning to generate a labeling tool and use supervised learning to generate a large scaled labeled dataset for further training [52].

2.4. Reinforcement Learning

Reinforcement learning is a reward-based system. The algorithm evolves as it interacts with the environment (dataset). A reward function is used to adjust the algorithm or the network. This type of AI is famous for playing chess, shogi, and Go through self-play [69] or generating data with GANs [70]. With this technique, researchers can develop a self-evolving AI for nodule hunting on CT images and achieve better accuracy [15,71,72].

## AI Good – Manufacturing

### 1nc/2ac

#### AI good for manufacturing – data processing allows for multiple significant improvements and maintenance

**Rapp, writer/editor for NIST's Manufacturing Extension Partnership, 2022**

[Katie, “Artificial Intelligence in Manufacturing: Real World Success Stories and Lessons Learned”, NIST, January 7, 2022, <https://www.nist.gov/blogs/manufacturing-innovation-blog/artificial-intelligence-manufacturing-real-world-success-stories>, accessed July 6, 2022, GDI-LL]

Using AI in a manufacturing context means using data to make actionable decisions faster and more accurately than a human can do. There are two specific areas where this makes a lot of sense: for forecasting and for understanding anomalies or outliers. There are parts of the manufacturing process where forecasting can drive value. If you have enough historic data and context about the decisions and process around the data, there’s a good chance that you can develop predictions. Why do the same inputs on the same machines sometimes have different outcomes? Is there an occasional manufacturing scenario that you want to understand? The data off one machine can be overwhelming to a human analyst, so that’s where AI can help. In addition, manufacturing systems are holistic and one metric in part of the process relates to another part of the same process. If you’re only looking at one area, how do you know what’s going on in another? AI can be the solution.

There are five areas where AI creates a significant financial impact.

1. Predictive maintenance. By taking historic data from maintenance logs, you can predict how a machine will behave under a future payload, whether you’ll need to fix it, when, why and how – based on what fixed that problem in the past. This can reduce downtime significantly.

2. Predictive quality. Predicting and reducing failures can yield significant cost savings.

3. Scrap reduction. Using metrics to predict behavior across product specifications can minimize scrap and maximize product quality.

4. Increasing yield/thruput. Predicting if and when a machine or process will no longer meet given specifications enables you to proactively do what’s needed to bring it back into specification, reducing quality passes.

5. Demand and inventory forecasting. With a thorough understanding of plant operations and the data behind production, it’s possible to forecast the demand and movement of critical parts, resulting in significant inventory savings.

### Extension Manufacturing Efficiency

#### AI improves manufacturing efficiency through managed workflows and quality checks

**Newton, Editor-In-Chief of Revolutionized, 2022**

[Emily, “How Are AI and Robotics Increasing Manufacturing Quality and Efficiency?”, IoT Times, January 12, 2022, <https://iot.eetimes.com/how-are-ai-and-robotics-increasing-manufacturing-quality-and-efficiency/>, accessed July 6, 2022, GDI-LL]

Manufacturers face increasingly unpredictable demand, rising consumer expectations and a significant labor shortage. The rise of Industry 4.0 technology is helping companies navigate these challenges by improving product quality and streamlining factory workflows. Artificial intelligence and robots are helping to improve quality and efficiency in manufacturing. This is how AI and robotics are transforming the sector right now. These technologies are likely to have a long-term impact. AI-ENABLED PREDICTIVE ANALYTICS HELP IMPROVE MANUFACTURING QUALITY AND STREAMLINE MAINTENANCE The pattern-finding abilities of artificial intelligence (AI) make it a good tool for manufacturers wanting to more effectively navigate existing market conditions and boost productivity. Artificial intelligence is primarily used to improve maintenance operations by reducing downtime and enabling more flexible manufacturing workflows.

### Extension Predictive maintenance

#### AI systems lower costs and downtime of machines, results in increased productivity

**Rapp, writer/editor for NIST's Manufacturing Extension Partnership, 2022**

[Katie, “Artificial Intelligence in Manufacturing: Real World Success Stories and Lessons Learned”, NIST, January 7, 2022, <https://www.nist.gov/blogs/manufacturing-innovation-blog/artificial-intelligence-manufacturing-real-world-success-stories>, accessed July 6, 2022, GDI-LL]

These AI systems are typically enabled by another Industry 4.0 technology, Internet of Things (IoT) sensors. They connect to the internet to continuously send and receive data on machine performance. In addition to providing managers with a real-time picture of equipment health and operation, they also provide the information needed for a predictive maintenance scheme.

These sensors can track a wide range of operational parameters and variables, including temperature, vibration, ultrasonic sound and even lubrication. This enables the AI system to uncover subtle correlations between operations and machine failure, helping businesses see mechanical issues coming before they become obvious.

These AI systems can also take advantage of quality and product information, allowing them to draw connections between manufacturing errors and operational parameters. In practice, this could enable a business to automatically detect operating conditions — like too-high temperatures or extreme vibration — that could be causing defects.

Key benefits of predictive maintenance systems include lower maintenance costs, increased machine life span and lower downtime. All this can reduce overall operating costs and boost site productivity.

Research from McKinsey suggests that a predictive maintenance scheme can save businesses 18%-25% on costs and increase production line availability by as much as 15%.

Savings for businesses that currently rely on reactive maintenance will be much higher than establishments with a preventive maintenance scheme in place.

### Extension Automated Robotic manufacturing

#### AI powered robots increase productivity – safety, flexible redeployment of robots to meet manufacturing needs

**Newton, Editor-In-Chief of Revolutionized, 2022**

[Emily, “How Are AI and Robotics Increasing Manufacturing Quality and Efficiency?”, IoT Times, January 12, 2022, <https://iot.eetimes.com/how-are-ai-and-robotics-increasing-manufacturing-quality-and-efficiency/>, accessed July 6, 2022, GDI-LL]

NEW ROBOTS ARE ESSENTIAL FOR MANUFACTURING EFFICIENCY

Robots are making existing processes more efficient. Some of the novel versions fill a similar niche as existing robotics, automating package filling and sorting tasks and helping to reduce overall labor needs.

Many manufacturing robots also take advantage of AI and the cloud to support workers directly involved in manufacturing. These machines do not replace workers but instead help them to work more productively or manage tasks that may be tedious or repetitive.

AUTONOMOUS ROBOTS CAN IMPROVE MANUFACTURING EFFICIENCY

Artificial intelligence has enabled highly autonomous robots. They can pilot themselves around environments like factories and perform some tasks entirely on their own, with no need for human oversight.

Examples of these robots include autonomous mobile robots (AMRs), commonly used in warehouses to move goods and raw materials around the facility. They are equipped with cameras, sensors and a direct connection to the cloud that allows them to use AI to navigate around obstacles and workers without a pilot. Built-in safety features like wireless e-stopping ensure the robots can work safely near workers on the factory floor.

Like many modern robots, they can typically be quickly programmed or reprogrammed, meaning they can change functions depending on current market conditions and manufacturing needs.

These robots can help manufacturers increase productivity when hiring additional workers isn’t possible or practical. In the future, they may also enable lights-out factories, where the only employees are technicians and managers who repair robots, coordinate activities and make production decisions.

### Extension Cobots – multiple tasks

#### AI powered Collaborative Robots increase productivity, quality, and efficiency

**Newton, Editor-In-Chief of Revolutionized, 2022**

[Emily, “How Are AI and Robotics Increasing Manufacturing Quality and Efficiency?”, IoT Times, January 12, 2022, <https://iot.eetimes.com/how-are-ai-and-robotics-increasing-manufacturing-quality-and-efficiency/>, accessed July 6, 2022, GDI-LL]

COLLABORATIVE ROBOTS CAN BOOST MANUFACTURING QUALITY

Another key trend in robotics has been collaborative robots (cobots). These are robots built to work safely with people. Design features like force limiters, padded edges and AI-powered machine vision make it possible for cobots to work with fewer safety risks.

These robots are used for various manufacturing tasks, including machine tending, picking and packing, and quality assurance. Many cobots are built to handle multiple tasks or slot easily into and out of manufacturing workflows, helping companies increase productivity without sacrificing site flexibility.

They can help make workers more productive, streamlining tedious tasks and improving the efficiency of jobs that cannot be fully automated.

NEW AI AND ROBOTICS TECHNOLOGY CAN STREAMLINE MANUFACTURING QUALITY

Manufacturers face a challenging market. Tools and technology that help businesses boost quality or efficiency are invaluable as a result.

New AI and robotics innovations can make manufacturing processes much more efficient. Predictive maintenance and collaborative robotics can significantly improve uptime, reduce maintenance costs and streamline operations, even when labor or supply shortages make typical workflows difficult to achieve. This boost in quality can put companies at a competitive advantage and help them stay ahead in the market.

# AI Development – not inevitable-ish

## AI investment – low-ish

### US low investment – federal government

#### Federal government involvement and contracting results in growth or stagnation for AI

**Arnold, 2020**

[Zachary “What investment trends reveal about the global AI landscape” Brookings September 29, 2020 <https://www.brookings.edu/techstream/what-investment-trends-reveal-about-the-global-ai-landscape/> GDI – TM]

“We aren’t what we were in the ’50s and ’60s and ’70s,” former Secretary of Defense Ash Carter recently reflected. “In those days, all technology of consequence for protecting our people, and all technology of any consequence at all, came from the United States and came from within the walls of government. Those days are irrevocably lost.” To get that technology now, “I’ve got to go outside the Pentagon no matter what,” Carter added. The former Pentagon chief may be overstating the case, but when it comes to artificial intelligence, there’s no doubt that the private sector is in command. Around the world, nations and their governments rely on private companies to build their AI software, furnish their AI talent, and produce the AI advances that underpin economic and military competitiveness. The United States is no exception. With Big Tech’s titans and endless machine-learning startups racing ahead on AI, it’s easy to imagine that the public sector has little to contribute. But the federal government’s choices on R&D policy, immigration, antitrust, and government contracting could spell the difference between growth and stagnation for America’s AI industry in the coming years. Meanwhile, as AI booms in other countries, diplomacy and trade policy can help the United States and its private sector take greatest advantage of advances abroad, and protective measures against industrial espionage and unfair competition can help keep America ahead of its adversaries.

### US losing lead

#### Investment trends put US lead at risk

**Arnold, 2020**

[Zachary “What investment trends reveal about the global AI landscape” Brookings September 29, 2020 <https://www.brookings.edu/techstream/what-investment-trends-reveal-about-the-global-ai-landscape/> GDI – TM]

Although America’s nearest rival for AI supremacy may not have taken the lead, our data suggest the United States shouldn’t grow complacent. America’s AI companies remain ahead in overall transaction value, but they account for a steadily shrinking percentage of global transactions. And by our estimates, investment outside the United States and China is quickly expanding, with Israel, India, Japan, Singapore, and many European countries growing faster than their larger competitors by some or all metrics.

### Investment low now – military specific

#### tag

**Arnold, 2020**

[Zachary “What investment trends reveal about the global AI landscape” Brookings September 29, 2020 <https://www.brookings.edu/techstream/what-investment-trends-reveal-about-the-global-ai-landscape/> GDI – TM]

When it comes to specific applications, we found that most AI companies are focused on transportation, business services, or general-purpose applications. There are some differences across borders: Compared to the rest of the world, investment into Chinese AI companies is concentrated in transportation, security and biometrics (including facial recognition), and arts and leisure, while in the United States and other countries, companies focused on business uses, general-purpose applications, and medicine and life sciences attract more capital.

Across all countries, though, relatively few private-market investments seem to be flowing to companies that focus squarely on military and government AI applications. Even the related category of security and biometrics is relatively small, though materially larger in China. Governments can and do adapt commercial AI tools for their own purposes, but for the time being, relatively few AI startups seem to be working and raising funds with public-sector clients in mind, especially outside China.

# AI Bad/not so good – Impact Debate

## AI Bad – Laundry list

### 1nc/2ac

#### AI generate multiple adverse consequences

**Acemoğlu,** Professor of Applied Economics, MIT, **2021**

[Daron “Dangers of unregulated artificial intelligence” Vox EU November 23 2021 <https://voxeu.org/article/dangers-unregulated-artificial-intelligence> GDI-TM]

Artificial intelligence (AI) is often touted as the most exciting technology of our age, promising to transform our economies, lives, and capabilities. Some even see AI as making steady progress towards the development of ‘intelligence machines’ that will soon surpass human skills in most areas. AI has indeed made rapid advances over the last decade or so, especially owing to the application of modern statistical and machine learning techniques to huge unstructured data sets. It has already influenced almost all industries: AI algorithms are now used by all online platforms and in industries that range from manufacturing to health, finance, wholesale, and retail. Government agencies have also started relying on AI, particularly in the criminal justice system and in customs and immigration control.

In a recent paper (Acemoglu 2021), I argue that current AI technologies — especially those based on the currently dominant paradigm relying on statistical pattern recognition and big data — are more likely to generate various adverse social consequences, rather than the promised gains.

These harms can be seen in product markets and advertising, in terms of inequality, wage suppression and job destruction in labour markets, and in the broader societal effects of AI in the context of social communication, political discourse, and democracy.

## AI Bad - AI arms racing

### 1nc/2ac – AI arms race escalatory war

#### AI arms race risk triggering accidental war – that escalates

**Grossman 21**

(Gary Grossman, Senior VP of Technology Practice at Edelman and Global Lead of the Edelman AI Center of Excellence, “The AI arms race has us on the road to Armageddon” VentureBeat, April 19th 2021, https://venturebeat.com/2021/04/19/the-ai-arms-race-has-us-on-the-road-to-armageddon/, accessed 7/7/2022, GDI- TMK)

The accelerating AI arms race Work to incorporate AI into the military is already far advanced. For example, militaries in the U.S., Russia, China, South Korea, the United Kingdom, Australia, Israel, Brazil, and Iran are developing cybersecurity applications, combat simulations, drone swarms, and other autonomous weapons. A recently completed “global information dominance exercise” by U.S. Northern Command pointed to the tremendous advantages the Defense Department can achieve by applying machine learning and artificial intelligence to all-domain information. The exercise integrated information from all domains including space, cyberspace, air, land, sea, and undersea, according to Air Force Gen. Glen D. VanHerck. Gilman Louie, a commissioner on the NSCAI report, is quoted in a news article saying: “I think it’s a mistake to think of this as an arms race” — though he added, “We don’t want to be second.” A dangerous pursuit West Point has started training cadets to consider ethical issues when humans lose some control over the battlefield to smart machines. Along with the ethical and political issues of an AI arms race are the increased risks of triggering an accidental war. How might this happen? Any number of ways, from a misinterpreted drone strike to autonomous jet fighters with new algorithms. AI systems are trained on data and reflect the quality of that data along with any inherent biases and assumptions of those developing the algorithms. Gartner predicts through 2023, up to 10% of AI training data will be poisoned by benign or malicious actors. That is significant, especially considering the security vulnerability of critical systems. When it comes to bias, military applications of AI are presumably no different, except that the stakes are much higher than whether an applicant gets a good rate on car insurance. Writing in War on the Rocks, Rafael Loss and Joseph Johnson argue that military deterrence is an “extremely complex” problem — one that any AI hampered by a lack of good data will not likely be able to provide solutions for in the immediate future. How about assumptions? In 1983, the world’s superpowers drew near to accidental nuclear war, largely because the Soviet Union relied on software to make predictions that were based on false assumptions. Seemingly this could happen again, especially as AI increases the likelihood that humans would be taken out of decision making. It is an open question whether the risks of such a mistake are higher or lower with greater use of AI, but Star Trek had a vision in 1967 for how this could play out. The risks of conflict had escalated to such a degree in a “Taste of Armageddon” that war was outsourced to a computer simulation that decided who would perish. There is no putting the genie back in the bottle. The AI arms race is well underway and leading militaries worldwide do not want to be in second place or worse. Where this will lead is subject to conjecture. Clearly, however, the wars of the future will be fought and determined by AI more than traditional “military might.” The ethical use of AI in these applications remains an open-ended issue. It was within the mandate of the NSCAI report to recommend restrictions on how the technology should be used, but this was unfortunately deferred to a later date.

## Extension AI Bad - AI arms racing

### Uniqueness – AI arms race underway

#### AI arms race underway now and threatens escalation, full automation of conflicts, and ethics violations.

**Grossman 21**

(Gary Grossman, Senior VP of Technology Practice at Edelman and Global Lead of the Edelman AI Center of Excellence, “The AI arms race has us on the road to Armageddon” VentureBeat, April 19th 2021, https://venturebeat.com/2021/04/19/the-ai-arms-race-has-us-on-the-road-to-armageddon/, accessed 7/7/2022, GDI- TMK)

It’s now a given that countries worldwide are battling for AI supremacy. To date, most of the public discussion surrounding this competition has focused on commercial gains flowing from the technology. But the AI arms race for military applications is racing ahead as well, and concerned scientists, academics, and AI industry leaders have been sounding the alarm. Compared to existing military capabilities, AI-enabled technology can make decisions on the battlefield with mathematical speed and accuracy and never get tired. However, countries and organizations developing this tech are only just beginning to articulate ideas about how ethics will influence the wars of the near future. Clearly, the development of AI-enabled autonomous weapons systems will raise significant risks for instability and conflict escalation. However, calls to ban these weapons are unlikely to succeed. In an era of rising military tensions and risk, leading militaries worldwide are moving ahead with AI-enabled weapons and decision support, seeking leading-edge battlefield and security applications. The military potential of these weapons is substantial, but ethical concerns are largely being brushed aside. Already they are in use to guard ships against small boat attacks, search for terrorists, stand sentry, and destroy adversary air defenses. For now, the AI arms race is a cold war, mostly between the U.S., China, and Russia, but worries are it will become more than that. Driven by fear of other countries gaining the upper hand, the world’s military powers have been competing by leveraging AI for years — dating back at least to 1983 — to achieve an advantage in the balance of power. This continues today. Famously, Russian President Vladimir Putin has said the nation that leads in AI will be the “ruler of the world.”

### Uniqueness - Increase military investment

#### AI investment by militaries seeking operational advantage – increase funding military AI readiness

**Grossman 21**

(Gary Grossman, Senior VP of Technology Practice at Edelman and Global Lead of the Edelman AI Center of Excellence, “The AI arms race has us on the road to Armageddon” VentureBeat, April 19th 2021, https://venturebeat.com/2021/04/19/the-ai-arms-race-has-us-on-the-road-to-armageddon/, accessed 7/7/2022, GDI- TMK)

How policy lines up behind military AI use According to an article in Salon, diverse and ideologically-distinct research organizations including the Center for New American Security (CNAS), the Brookings Institution, and the Heritage Foundation have argued that America must ratchet up spending on AI research and development. A Foreign Affairs article argues that nations who fail to embrace leading technologies for the battlefield will lose their competitive advantage. Speaking about AI, former U.S. Defense Secretary Mark Esper said last year, “History informs us that those who are first to harness once-in-a-generation technologies often have a decisive advantage on the battlefield for years to come.” Indeed, leading militaries are investing heavily in AI, motivated by a desire to secure military operational advantages on the future battlefield. Civilian oversight committees, as well as militaries, have adopted this view. Last fall, a U.S. bipartisan congressional report called on the Defense Department to get more serious about accelerating AI and autonomous capabilities. Created by Congress, the National Security Commission on AI (NSCAI) recently urged an increase in AI R&D funding over the next few years to ensure the U.S. is able to maintain its tactical edge over its adversaries and achieve “military AI readiness” by 2025. In the future, warfare will pit “algorithm against algorithm,” claims the new NSCAI report. Although militaries have continued to compete using weapon systems similar to those of the 1980s, the NSCAI report claims: “the sources of battlefield advantage will shift from traditional factors like force size and levels of armaments to factors like superior data collection and assimilation, connectivity, computing power, algorithms, and system security.” It is possible that new AI-enabled weapons would render conventional forces near obsolete, with rows of decaying Abrams tanks gathering dust in the desert in much the same way as mothballed World War II ships lie off the coast of San Francisco. Speaking to reporters recently, Robert O. Work, vice chair of the NSCAI said of the international AI competition: “We have got … to take this competition seriously, and we need to win it.”

## AI Bad - authoritarian governments

### 1nc/2ac – authoritarian repression

#### AI increases tools of authoritarian repression – China proves

**Donahoe 21**

(Eileen Donahoe, Executive Director at the Stanford Global Digital Policy Incubator, previously served as the first US Ambassador to the United Nations Human Rights Council in Geneva, former director of global affairs at Human Rights Watch, “System Rivalry: How Democracies Must Compete with Digital Authoritarians,” Just Security, September 27th 2021, https://www.justsecurity.org/78381/system-rivalry-how-democracies-must-compete-with-digital-authoritarians/, accessed 7/7/22, GDI- TMK)

Artificial intelligence (AI) may still hold the potential to solve some of the world’s most intractable problems and help fulfill the UN Sustainable Development Goals (SDGs), but when it comes to risks to privacy and civil liberties, AI already has been a game changer in favor of authoritarian states. AI-enabled tools have turbocharged every pre-existing form of repression including: mass and targeted surveillance, censorship, and the spread of propaganda. Contrary to the original expectation that it would be impossible for repressive states to control the open internet, AI has facilitated a whole new level of state control over communications infrastructure and the information realm. Its technological advantages include scaled capacity to scan for forbidden content and filter out dissenting views. In the other direction — the production of ideas — autocrats have found new ability to control public narratives and shape civic discourse with AI-generated and amplified content. New social engineering tools, such as China’s social-credit system, mold citizens’ motivations and behaviors. Beyond violating privacy and civil liberties, these systems have the potential to destroy, in significant part, human agency and human dignity. The larger threat posed by all these AI-enabled technologies is that they are facilitating the spread of digital authoritarianism: an encompassing techno-social system and governance model that involves control and security for the state as opposed to liberty and security for citizens. Rather than view the challenge as a series of discrete apps used for repression, democracies should see digital authoritarianism through the lens of system rivalry and recognize that they face competition from a powerful, repressive governance model spreading around the world. This model is being propagated through a variety of means. It certainly includes the diffusion of technology, but it also includes the diffusion of values, norms, and concepts related to appropriate uses of and constraints on technology. The authoritarian model is also spread through propaganda and economic coercion, sometime referred to as “sharp power,” and even through concerted efforts to influence tech standard-setting bodies, where repressive potential can be embedded in tech protocols for the future. These elements generally come as a package deal. China as Model of Digital Authoritarianism The starkest example of digital authoritarianism is China’s version, which is manifesting global influence on multiple layers. First, China has become a role-model of AI-driven domestic repression, with highly escalated surveillance capacities in their own “smart cities” and panopticon-level control in regions deemed “security threats,” such as Xinjiang. They have demonstrated stunningly effective control over the domestic information realm and the ability to steers citizens’ behavior with powerful incentives built into their social credit system. China also is advancing development of a sovereign digital currency that will substantially enhance their repressive powers at home. Second, China is exporting these repressive capacities and normalizing their use around the world. Through broader economic trade and development initiatives, such as its Belt and Road and Digital Silk Road, China has built entire infrastructure systems through which it has gained leverage over fragile states that will last for decades to come, as well as new sources of data that can be sucked back to Beijing. Third, China is shaping debate in international normative arenas by flooding the zone of multilateral tech-related diplomacy. Their advocacy has been very effective within normative bodies like the UN Human Rights Council, where China has swayed the majority of delegations to support their repressive uses of technology in Hong Kong and Xinjiang. They also have demonstrated an ability to exert influence at tech standard-setting bodies, like the International Telecommunications Industry (ITU), where interoperability standards for the future are set. Their aim has been to push China’s preferred protocols as the global default for Internet of things (IOT) and other emerging technologies. Fourth, in the global marketplace of ideas, China is spreading propaganda about the weakness of democracy, using so-called “Wolf Warrior” diplomats who aggressively attack the competence of democracies, particularly the United States, its only superpower rival. China has also advanced internet governance concepts like “cyber sovereignty,” which is essentially an updated version of a long-standing authoritarian position that repression within sovereign, now cyber borders, should not be criticized by external actors based on international human rights law and principles. Finally, we cannot ignore the fact that China’s growing global influence started with massive strategic investment in emerging technology. China recognized very early that dominance in technology would translate into power across other realms – military, economic, geopolitical, normative. The Chinese Communist Party publicly committed to win the AI-race against the US by 2030 and has made deep investments in other emerging technologies, such as quantum computing. Their current push to be first in developing a sovereign digital currency is another manifestation of their sophisticated understanding of the linkage between technology prominence and global power. The bottom line: The Chinese government is on a mission to remake the 21st century global order in its own image and in accordance with its own repressive values. Democratic governments and stakeholders need to recognize the existential threat posed by this competing digital authoritarian model.

## Extension AI Bad - authoritarian governments

### Extension - AI – human rights violations

#### AI based surveillance increase human rights violations

**United Nations OHCHR ‘21**

(United Nations Office of the High Commissioner on Human Rights, the High Commissioner for Human Rights is the principal human rights official of the United Nations, “Artificial intelligence risks to privacy demand urgent action – Bachelet,” United Nations, September 15th 2021, https://www.ohchr.org/en/2021/09/artificial-intelligence-risks-privacy-demand-urgent-action-bachelet, accessed 7/7/22, GDI- TMK)

GENEVA (15 September 2021) – UN High Commissioner for Human Rights Michelle Bachelet on Wednesday stressed the urgent need for a moratorium on the sale and use of artificial intelligence (AI) systems that pose a serious risk to human rights until adequate safeguards are put in place. She also called for AI applications that cannot be used in compliance with international human rights law to be banned. “Artificial intelligence can be a force for good, helping societies overcome some of the great challenges of our times. But AI technologies can have negative, even catastrophic, effects if they are used without sufficient regard to how they affect people’s human rights,” Bachelet said. As part of its work\* on technology and human rights, the UN Human Rights Office has today published a report that analyses how AI – including profiling, automated decision-making and other machine-learning technologies – affects people’s right to privacy and other rights, including the rights to health, education, freedom of movement, freedom of peaceful assembly and association, and freedom of expression. “Artificial intelligence now reaches into almost every corner of our physical and mental lives and even emotional states. AI systems are used to determine who gets public services, decide who has a chance to be recruited for a job, and of course they affect what information people see and can share online,” the High Commissioner said. The report looks at how States and businesses alike have often rushed to incorporate AI applications, failing to carry out due diligence. There have already been numerous cases of people being treated unjustly because of AI, such as being denied social security benefits because of faulty AI tools or arrested because of flawed facial recognition. The report details how AI systems rely on large data sets, with information about individuals collected, shared, merged and analysed in multiple and often opaque ways. The data used to inform and guide AI systems can be faulty, discriminatory, out of date or irrelevant. Long-term storage of data also poses particular risks, as data could in the future be exploited in as yet unknown ways. “Given the rapid and continuous growth of AI, filling the immense accountability gap in how data is collected, stored, shared and used is one of the most urgent human rights questions we face,” Bachelet said. The inferences, predictions and monitoring performed by AI tools, including seeking insights into patterns of human behaviour, also raise serious questions. The biased datasets relied on by AI systems can lead to discriminatory decisions, and these risks are most acute for already marginalized groups. “The risk of discrimination linked to AI-driven decisions – decisions that can change, define or damage human lives – is all too real. This is why there needs to be systematic assessment and monitoring of the effects of AI systems to identify and mitigate human rights risks,” Bachelet said. There also needs to be much greater transparency by companies and States in how they are developing and using AI. “The complexity of the data environment, algorithms and models underlying the development and operation of AI systems, as well as intentional secrecy of government and private actors are factors undermining meaningful ways for the public to understand the effects of AI systems on human rights and society,” the report says. “We cannot afford to continue playing catch-up regarding AI – allowing its use with limited or no boundaries or oversight, and dealing with the almost inevitable human rights consequences after the fact. The power of AI to serve people is undeniable, but so is AI’s ability to feed human rights violations at an enormous scale with virtually no visibility. Action is needed now to put human rights guardrails on the use of AI, for the good of all of us,” Bachelet stressed.

## AI Bad – automation of jobs

### 1nc/2ac

#### AI job automation multiple sectors and industry – new wave of faster displacements occurring

**Bangert, strategy and innovation consultant, 2022**

[Valerias, “AI is quietly eating up the world’s workforce with job automation”, VentureBeat, January 8, 2022, <https://venturebeat.com/2022/01/08/ai-is-quietly-eating-up-the-worlds-workforce-with-job-automation/>, accessed July 8, 2022, GDI-LL]

The implications of AI job automation Just two years ago, the idea of AI automating jobs like creative roles was the stuff of science fiction or at least relegated to a few early-adopting businesses. But now, AI is becoming table stakes for many businesses. In other words, if you’re not using AI, you’re at a disadvantage. The major reason for this is that large language model, primarily OpenAI’s GPT-3, have become much better at understanding natural language. The examples given so far are just the tip of the iceberg. AI is automating jobs away in virtually every sector and industry. While this might seem like cause for alarm, it’s actually long overdue news. The fact is, we’ve been living in a world where machines have been slowly replacing human workers for centuries. What’s new is the pace of this automation. Machines are now becoming faster, better, and cheaper than humans at an alarming rate. As a result, we’re seeing a fundamental shift in the economy where machines are starting to do the creative jobs of human beings. Amidst the opportunity to automate away jobs, a new wave of AI-focused startups has emerged, all seeking to cash in on the potential of AI. This AI gold rush is evidenced by the billions of dollars in venture funding that has flowed into AI startups in recent months. In the third quarter of 2021 alone, nearly $18 billion was invested in AI companies, a record high. This influx of capital is a sign that investors believe in the potential of AI, and they are betting that it will eventually automate away many jobs, generating that value with machines instead. In the meantime, we should prepare ourselves for a future in which AI is quietly eating up the world’s workforce.

## Extension AI Bad - automation of jobs – unemployment/populism

### Extension - AI job displacement – numbers

#### Increased automation of jobs widens inequality and causes worker displacement

**Holzer, Nonresident Senior Fellow - Economic Studies, 2022**

[Harry, “Understanding the impact of automation on workers, jobs, and wages”, Brookings, January 19, 2022, <https://www.brookings.edu/blog/up-front/2022/01/19/understanding-the-impact-of-automation-on-workers-jobs-and-wages/>, accessed July 8, 2022, GDI-LL]

The “new automation” of the next few decades—with much more advanced robotics and artificial intelligence (AI)—will widen the range of tasks and jobs that machines can perform, and have the potential to cause much more worker displacement and inequality than older generations of automation. This can potentially affect college graduates and professionals much more than in the past. Indeed, the new automation will eliminate millions of jobs for vehicle drivers and retail workers, as well as those for health care workers, lawyers, accountants, finance specialists, and many other professionals.

The new automation will eliminate millions of jobs for vehicle drivers and retail workers, as well as those for health care workers, lawyers, accountants, finance specialists, and many other professionals.

### Extension - Displacement/wage inequality

#### Digital automation increase wage disparity – and increase business profits over labor

**Holzer, Nonresident Senior Fellow - Economic Studies, 2022**

[Harry, “Understanding the impact of automation on workers, jobs, and wages”, Brookings, January 19, 2022, <https://www.brookings.edu/blog/up-front/2022/01/19/understanding-the-impact-of-automation-on-workers-jobs-and-wages/>, accessed July 8, 2022, GDI-LL]

On the other hand, there are workers who lose out, particularly those directly displaced by the machines and those who must now compete with them. Indeed, digital automation since the 1980s has added to labor market inequality, as many production and clerical workers saw their jobs disappear or their wages decline. New jobs have been created—including some that pay well for highly educated analytical workers. Others pay much lower wages, such as those in the personal services sector.

More broadly, workers who can complement the new automation, and perform tasks beyond the abilities of machines, often enjoy rising compensation. However, workers performing similar tasks, for whom the machines can substitute, are left worse off. In general, automation also shifts compensation from workers to business owners, who enjoy higher profits with less need for labor.

#### Displacement from jobs lower wages and increase inequality – translation jobs prove

**Bangert, strategy and innovation consultant, 2022**

[Valerias, “AI is quietly eating up the world’s workforce with job automation”, VentureBeat, January 8, 2022, <https://venturebeat.com/2022/01/08/ai-is-quietly-eating-up-the-worlds-workforce-with-job-automation/>, accessed July 8, 2022, GDI-LL]

Robo-translators Translation has, of course, long been at risk of automation. However, the advent of large language models is making human translators increasingly vulnerable to replacement by AI. In a 2020 research paper, it was shown that a Transformer-based deep learning system outperforms human translators. This study is significant because it shows that AI translators are not just as good as, but often better than, human translators.a What’s more, the rise of AI translators is likely to have a negative effect on the wages of human translators. As AI translation becomes more common, the demand for human translators will decrease, and their wages will accordingly drop. While many economists once worried about the impact of outsourcing on the white-collar workforce, the coming wave of AI will have an even more serious impact, across sectors. In fact, as Forbes reports**, AI job automation has already been the primary driver in U.S. income inequality** over the past 40 years.

### Extension - Job displacement – no reemployment

#### AI based job automation displace workers without re-employment

**Bangert, strategy and innovation consultant, 2022**

[Valerias, “AI is quietly eating up the world’s workforce with job automation”, VentureBeat, January 8, 2022, <https://venturebeat.com/2022/01/08/ai-is-quietly-eating-up-the-worlds-workforce-with-job-automation/>, accessed July 8, 2022, GDI-LL]

Robo-support

This trend is not limited to writing. AI is also automating jobs in customer service, accounting, and a host of other professions. For instance, companies like Thankful, Yext, and Forethought use AI to automate customer support. This shift is often imperceptible to the customer, who doesn’t know if they’re speaking to a biological intelligence or a machine. The rise of AI-powered customer service has big implications for the workforce. It’s estimated that 85 percent of customer interactions are already handled without human interaction.

According to the Bureau of Labor Statistics, there are nearly 3 million customer service representatives employed in the United States. Many of these jobs are at risk of being replaced by AI. When jobs like these are automated away, the question is: Where do the displaced workers go?

The answer is not clear. It’s possible that many of these workers will be re-employed in other fields. But it’s also possible that they will become unemployed, and that the economy will struggle to absorb them. This is driving calls for a universal basic income, in which the government provides all citizens with a basic income to live on, to offset job losses due to automation.

## AI Bad - autonomous weapons

### 1nc/2ac

#### AI military equipment provides accessory to human violence, even when non-lethal themselves – making conflict unpredictable and less accountable while increasing risks of atrocities

**Holland-Michael 20**

(Arthur Holland Michael, co-director of the Center for the Study of the Drone at Bard College and the author of Eyes in the Sky: The Secret Rise of Gorgon Stare and How It Will Watch Us All, “The Killer Algorithms Nobody’s Talking About,” Foreign Policy, January 20th 2020, https://foreignpolicy.com./2020/01/20/ai-autonomous-weapons-artificial-intelligence-the-killer-algorithms-nobodys-talking-about/, accessed 7/6/2022, GDI- TMK)

This past fall, diplomats from around the globe gathered in Geneva to do something about killer robots. In a result that surprised nobody, they failed. The formal debate over lethal autonomous weapons systems—machines that can select and fire at targets on their own—began in earnest about half a decade ago under the Convention on Certain Conventional Weapons, the international community’s principal mechanism for banning systems and devices deemed too hellish for use in war. But despite yearly meetings, the CCW has yet to agree what “lethal autonomous weapons” even are, let alone set a blueprint for how to rein them in. Meanwhile, the technology is advancing ferociously; militaries aren’t going to wait for delegates to pin down the exact meaning of slippery terms such as “meaningful human control” before sending advanced warbots to battle. To be sure, that’s a nightmarish prospect. U.N. Secretary-General António Guterres, echoing a growing chorus of governments, think tanks, academics, and technologists, has called such weapons “politically unacceptable” and “morally repugnant.” But this all overlooks an equally urgent menace**: autonomous systems that are not in themselves lethal but rather act as a key accessory to human violence**. Such tools—let’s call them lethality-enabling autonomous systems—might not sound as frightening as a swarm of intelligent hunter drones. But they could be terrifying. At best, they will make conflict far more unpredictable and less accountable. At worst, they could facilitate ghoulish atrocities. Many such technologies are already in use. Many more are right around the corner. And because of our singular focus on headline-grabbing killer robots, they have largely gone ignored. Militaries and spy services have long been developing and deploying software for autonomously finding “unknown unknowns”—potential targets who would have otherwise slipped by unnoticed in the torrent of data from their growing surveillance arsenals. One particularly spooky strand of research seeks to build algorithms that tip human analysts off to such targets by singling out cars driving suspiciously around a surveilled city. Other lethality-enabling technologies can translate intercepted communications, synthesize intelligence reports, and predict an adversary’s next move—all of which are similarly crucial steps in the lead-up to a strike. Even many entry-level surveillance devices on the market today, such as targeting cameras, come with standard features for automated tracking and detection. For its part, the U.S. Department of Defense, whose self-imposed rules for autonomous weapons specifically exempt nonlethal systems, is allowing algorithms dangerously close to the trigger. The Army wants to equip tanks with computer vision that identifies “objects of interest” (translation: potential targets) along with recommendation algorithms—kind of like Amazon’s—that advise weapons operators whether to destroy those objects with a cannon or a gun, or by calling in an airstrike**. All of these technologies fall outside the scope of the international debate on killer robots. But their effects could be just as dangerous**.

## Extension AI Bad - autonomous weapons

### Extension – escalation

#### Non-lethal autonous aids in war increase risk of escalation and worsen human mistakes, lack of regulations undermine checks on the system

**Holland-Michael 20**

(Arthur Holland Michael, co-director of the Center for the Study of the Drone at Bard College and the author of Eyes in the Sky: The Secret Rise of Gorgon Stare and How It Will Watch Us All, “The Killer Algorithms Nobody’s Talking About,” Foreign Policy, January 20th 2020, https://foreignpolicy.com./2020/01/20/ai-autonomous-weapons-artificial-intelligence-the-killer-algorithms-nobodys-talking-about/, accessed 7/6/2022, GDI- TMK)

The widespread use of sophisticated autonomous aids in war would be fraught with unknown unknowns. .An algorithm with the power to suggest whether a tank should use a small rocket or a fighter jet to take out an enemy could mark the difference between life and death for anybody who happens to be in the vicinity of the target. But different systems could perform that same calculation with widely diverging results. Even the reliability of a single given algorithm could vary wildly depending on the quality of the data it ingests. It is also difficult to know whether lethality-enabling artificial intelligence—prone as computers are to bias—would contravene or reinforce those human passions that all too often lead to erroneous or illegal killings. Nor is there any consensus as to how to ensure that a human finger on the trigger can be counted on as a reliable check against the fallibility of its algorithmic enablers. As such, in the absence of standards on such matters, not to mention protocols for algorithmic accountability, there is no good way to assess whether a bad algorithmically enabled killing came down to poor data, human error, or a deliberate act of aggression against a protected group. A well-intentioned military actor could be led astray by a deviant algorithm and not know it; but just as easily, an actor with darker motives might use algorithms as a convenient veil for an intentionally insidious decisions. If one system offers up a faulty conclusion, it could be easy to catch the mistake before it does any harm. But these algorithms won’t act alone. A few months ago, the U.S. Navy tested a network of three AI systems, mounted on a satellite and two different airplanes, that collaboratively found an enemy ship and decided which vessel in the Navy’s fleet was best placed to destroy it, as well as what missile it should use. The one human involved in this kill chain was a commanding officer on the chosen destroyer, whose only job was to give the order to fire. Eventually, the lead-up to a strike may involve dozens or hundreds of separate algorithms, each with a different job, passing findings not just to human overseers but also from machine to machine. Mistakes could accrue; human judgment and machine estimations would be impossible to parse from one another; and the results could be wildly unpredictable. These questions are even more troubling when you consider how central such technologies will become to all future military operations. As the technology proliferates, even morally upstanding militaries may have to rely on autonomous assistance, in spite of its many risks, just to keep ahead of their less scrupulous AI-enabled adversaries. And once an AI system can navigate complicated circumstances more intelligently than any team of soldiers, the human will have no choice but to take its advice on trust—or, as one thoughtful participant at a recent U.S. Army symposium put it, targeting will become a matter of simply pressing the “I-believe button.” In such a context, assurances from top brass that their machines will never make the ultimate lethal decision seem a little beside the point. Most distressing of all, automation’s vast potential to make humans more efficient extends to the very human act of committing war crimes. In the wrong hands, a multi-source analytics system could, say, identify every member of a vulnerable ethnic group. China’s Uighur population is already routinely submitted to exactly this kind of digital despotism; state and local authorities have deployed facial recognition tools capable of picking out members of the predominantly Muslim minority in closed-circuit TV footage, along with myriad other spying tools, to chart their every move. Imagine what such a technology could achieve in war. Militaries have long argued that AI will make conflict more precise. But that argument has a dark flipside: An algorithm designed to minimize civilian casualties could just as easily be used to calculate how civilian harm could be maximized. Governments must broaden the debate on killer robots to include all algorithmic links in the kill-chain. They need to consider how to align such systems to the fundamental laws of war, and model the complex interactions between disparate lethality-enabling systems so as to avoid nasty surprises. Finally, governments must develop inscrutable and transparent mechanisms to audit algorithms that go bad, as well as those humans who employ their algorithms badly. This could even streamline the debate in Geneva, which has largely broken down over disagreements as to what counts as a true lethal autonomous weapon. The norm-building process would no longer have to navigate the intellectually dubious distinction between warfighting AI and AI used by warfighters. Instead, the same fundamental principles could be applied equally to those algorithms that do the killing and those that are adjacent to it. If, on the other hand, the debate among policymakers remains narrowly focused on “killer robots,” these issues will remain unresolved until it’s too late. That would be an unacceptable mistake.

### Extension – unpredictability

#### AI lethal autonomous weapons remain unpredictable and risk removing human intervention on conflict escalation

**Davison and Horowitz 21**

(Neil Davison and Jonathon Horowitz, Davison is a scientific and policy adviser in the Legal Division at the ICRC headquarters in Geneva and Horowitz is a Legal Adviser at the ICRC Regional Delegation for the United States and Canada, “Adding AI to Autonomous Weapons Increases Risks to Civilians in Armed Conflict,” Just Security, March 26th 2021, https://www.justsecurity.org/75502/adding-ai-to-autonomous-weapons-increases-risks-to-civilians-in-armed-conflict/, accessed 7/6/2022, GDI- TMK)

Earlier this month, a high-level, congressionally mandated commission released its long-awaited recommendations for how the United States should approach artificial intelligence (AI) for national security. The recommendations were part of a nearly 800-page report from the National Security Commission on AI (NSCAI) that advocated for the use of AI but also highlighted important conclusions on key risks posed by AI-enabled and autonomous weapons, particularly the dangers of unintended escalation of conflict. The commission identified these risks as stemming from several factors, including system failures, unknown interactions between these systems in armed conflict, challenges in human-machine interaction, as well as an increasing speed of warfare that reduces the time and space for de-escalation. These same factors also contribute to the inherent unpredictability in autonomous weapons, whether AI-enabled or not. From a humanitarian and legal perspective, the NSCAI could have explored in more depth the risks such unpredictability poses to civilians in conflict zones and to international law. Autonomous weapons are generally understood, including by the United States and the ICRC, as those that select and strike targets without human intervention; in other words, they fire themselves. This means the user of an autonomous weapon does not choose a specific target and so they do not know exactly where (or when) a strike will occur, or even specifically who (or what) will be killed, injured or destroyed. AI-enabled autonomous weapons — particularly those that would “learn” what to target — complicate matters even further. Developers may not be able to predict, understand, or explain what happens within the machine learning “black box.” So how would users of the weapon verify how it will function in practice, or assess when it might not function as intended? This challenge is not unique to the United States or the types of technologies it is pursuing. It is a challenge fundamental to the international debate on AI-enabled and autonomous weapons. From a humanitarian perspective, the potential risks that autonomous weapons pose to civilians and civilian infrastructure in an armed conflict setting become quite stark when one considers that autonomous targeting functions could be a feature of (m)any of the expanding array of highly mobile armed drones – in the air, on land, or at sea. There are also serious legal issues to consider. Humans—not machines—must apply the rules of international humanitarian law (IHL, also known as the law of war or the law of armed conflict) and make context-specific judgements in attacks to minimize risks for civilians and civilian objects. The unpredictability of autonomous weapons undermines this decision-making process at worst and complicates it at best, including by potentially speeding up the process beyond human control. The NSCAI recommends that the United States excludes the use of autonomous nuclear weapons. Almost everyone agrees on this, but the question remains: What other constraints on autonomous weapons are needed to address humanitarian, legal, and ethical concerns? Finding these answers is becoming urgent as autonomous weapons are being rapidly developed and militaries are seeking to deploy them in armed conflicts. The commission itself points out the need for greater constraints, and heightened levels of human control in environments where more civilians are present – such as in urban areas. The ICRC, including in a recent report with the Stockholm International Peace Research Institute, has made some additional suggestions (submitted during the NSCAI’s consultations). Essentially, strict limits are needed on the types of autonomous weapons and the situations they are used in, as well as requirements for humans to supervise, intervene, and be able to switch them off. Some of these limits are borne of fundamental ethical concerns for humanity (and not only law). Public opinion surveys suggest most individuals would tend to agree that an algorithm should not “decide” whether someone lives or dies. After all, inanimate objects – software included – have no moral (or legal) agency, and over-reliance on algorithms can interfere with human agency. What this may mean is not that there would be a “moral imperative” to pursue autonomous weapons to replace human decision-makers, but rather that there may be a moral imperative to exclude autonomous weapons that target humans directly. This approach has gathered some support among experts with often opposing views on the risks, and is even reflected in concerns expressed by a former U.S. defence secretary about the proliferation of autonomous weapons. The commission also entered the debate on whether an international agreement, such as a new legally binding treaty, is needed to address autonomous weapons. It is clearly opposed, citing the obstacle of overcoming the lack of an internationally agreed definition; difficulty in verifying compliance; and concerns that U.S. adversaries would not comply. On the other hand, the NSCAI expressed concerns that adversaries might interpret existing legal obligations (and ethical considerations) differently and recommended that the United States “develop international standards of practice for the development, testing, and use of AI-enabled and autonomous weapon systems.” The ICRC has, since 2015, called for internationally agreed limits on autonomous weapons systems—whether new rules, policy standards or best practices; and developments at the international level are somewhat encouraging in this respect. There is increasing understanding among States about the types of international limits on autonomous weapons needed to address legal and ethical concerns. Such limits would have the dual advantage of building confidence in mutually agreed legal and ethical interpretations, while also managing the wider risks of conflict escalation. These are not problems that are likely to be solved by national approaches alone. None of the ICRC’s suggested limits would prevent countries from using AI to the extent it can support human decision-making in warfare that better complies with IHL and minimizes risks for civilians. But the unconstrained development and use of autonomous weapons pulls in the wrong direction for legal compliance and civilian protection

## AI Bad - policing

#### AI policing replicates bias and reinforces inequality, without accountability

**Reece 22**

(Hope Reece, a journalist who writes for The New York Times, The Atlantic, Vox, and other publications, “What Happens When Police Use AI to Predict and Prevent Crime?” JSTOR Daily, February 23rd 2022, https://daily.jstor.org/what-happens-when-police-use-ai-to-predict-and-prevent-crime/, accessed 7/6/22, GDI- TMK)

Bias in law enforcement has long been a problem in America. The killing of George Floyd, an unarmed Black man, by Minneapolis police officers in May 2020 most recently brought attention to this fact—sparking waves of protest across the country, and highlighting the ways in which those who are meant to “serve and protect” us do not serve all members of society equally. With the dawn of artificial intelligence (AI), a slew of new machine learning tools promise to help protect us—quickly and precisely tracking those who may commit a crime before it happens—through data. Past information about crime can be used as material for machine learning algorithms to make predictions about future crimes, and police departments are allocating resources towards prevention based on these predictions. The tools themselves, however, present a problem: The data being used to “teach” the software systems is embedded with bias, and only serves to reinforce inequality. Here’s how: Black people are more likely than white people to be reported for a crime—whether the reporter is white or Black. This leads to Black neighborhoods being marked as “high risk” at a disproportionate rate. Using data as a tool for policing is not new—it’s been going on since the 1990s, in an effort to help departments decide which communities are at “high risk.” If they know where the most crime happens, the thinking went, police could put more resources into policing a given area. However, the logic is faulty: If more police are dispatched to a certain neighborhood, it clearly follows that “more” crime will appear here. Essentially, it’s a feedback loop, which provides a skewed version of where crime is actually taking place. (Another issue at hand is the allocation of police resources rather than social services. There is much debate, for instance, about whether the role of police in certain poor, Black neighborhoods also tends to create a “police state” environment, in which citizens do not feel safe, and there are strong arguments that more funding for mental health or other social services would better serve these communities). When machine learning algorithms are fed this “data” to train their predictive systems, they replicate this bias, reinforcing false ideas about which neighborhoods are more “high risk.” Another problem with the thinking is that it relies on past information. While our past may give us a clue into future behavior, it does not take into consideration the concept of and potential for rehabilitation, and has the effect of reinforcing negative views, and continuing to punish those who have already paid their debt. Police departments across the globe are using these software programs to pinpoint crime. While there are dozens of American tech companies selling this type of software to law enforcement agencies, one particular startup, Voyager Labs, is collecting social media information—including Facebook posts, emojis, friends–and analyzing them to make connections, even cross-referencing this information with private data, to create a “holistic” profile that can be used to find people who pose “risks.” Inaccuracy and Bias Embedded in AI Systems Automated-policing approaches are often inaccurate. A 2018 trial conducted by the London Metropolitan Police used facial recognition to identify 104 previously unknown people who were suspected of committing crimes. Only 2 of the 104 were accurate. “From the moment a police officer wrongly identifies a suspect until the moment the officer realizes their error, significant coercive action can take place: the suspect can be arrested, brought to a police station and detained. It can be terrifying, with irreversible consequences, including human rights violations,” Edward Santow writes in The Australian Quarterly. Additionally, facial recognition systems have also demonstrated bias against people of color. In an egregious example, Facebook’s facial recognition algorithm labeled Black people “primates”—which it recently told the BBC “was clearly an unacceptable error.” Lack of Human Oversight in Automated Processes Automated systems remove human oversight. As law enforcement agencies increasingly rely on these deep learning tools, the tools themselves take on an authority, and their predictions are often unquestioned. This has resulted in what Kate Crawford and Jason Schultz, in their report “AI Systems as State Actors” call an “accountability gap,” which “may result in both state and private human employees having less knowledge or direct involvement in the specific decisions that cause harm.” The tools themselves could come from various sources—created “in-house” by government agencies, developed by contractors, or even donated, Crawford and Schultz point out. And with these various configurations, there is little information on who should be accountable when the systems fail. A new project by Columbia University, in tandem with the AI Now Institute and the New York University School of Law’s Center on Race, Inequality, and the Law, and the Electronic Frontier Foundation, was recently begun “to conduct an examination of current United States courtroom litigation where the use of algorithms by government was central to the rights and liberties at issue in the case.” In this report, the researchers focused on cases in which AI is currently being used in law enforcement: in the areas of Medicaid and disability benefits, public teacher evaluations, and criminal risk assessments. In these cases, the researchers looked at how the AI systems were used by humans. The authors concluded: These AI systems were implemented without meaningful training, support, or oversight, and without any specific protections for recipients. This was due in part to the fact that they were adopted to produce cost savings and standardization under a monolithic technology-procurement model, which rarely takes constitutional liability concerns into account. The focus of the algorithms were biased—in an effort to cut budgets, they targeted those who would be more likely to need support. “Thus, an algorithmic system itself, optimized to cut costs without consideration of legal or policy concerns, created the core constitutional problems that ultimately decided the lawsuits.” Like “traveling sales representatives,” the authors remarked, these automated tools would take information from one location to another, applying it to new populations, increasing the potential for bias to skew the results. “As AI systems rely more on deep learning, potentially becoming more autonomous and inscrutable, the accountability gap for constitutional violations threatens to become broader and deeper.” This raises the question: How should we hold the software companies themselves accountable? When automated systems are given free rein, and human oversight becomes obsolete, should tech companies assume responsibility for how their products are used? The law is still unclear on this issue. “When challenged, many state governments have disclaimed any knowledge or ability to understand, explain, or remedy problems created by AI systems that they have procured from third parties,” Crawford and Schultz argue. “The general position has been “we cannot be responsible for something we don’t understand.” This means that algorithmic systems are contributing to the process of government decision making without any mechanisms of accountability or liability.” A failure to address this accountability gap should mean a halt in the use of these tools

## Impact defense

### AI not key to gender violence

#### AI used again gender violence perpetuated racism and wastes resources.

**Brody 19**

(Liz Brody, journalist and recipient of National Magazine Award, “How Artificial Intelligence Is Tracking Sex Traffickers,” Medium, May 8th 2019, https://onezero.medium.com/how-artificial-intelligence-is-tracking-sex-traffickers-276dcc025ecd, accessed 7/6/22, GDI- TMK)

Timea Nagy wishes these tools had been available when she was trafficked. As a 20-year-old in Budapest, she answered an ad promising quick money in Canada. She thought she’d be working as a nanny, or at worst cleaning houses. Instead she wound up captive in a Toronto motel, forced into sex work and erotic dancing. Nagy only escaped by finding a couple of people in the club and pointing to words like “scared” and “help” in her Hungarian-English dictionary.Two of her perpetrators were never caught and now, 21 years later, she still has nightmares about running from them. By day she fights back, however, and her many years of activism include advising Traffic Jam and now working with DeliverFund. Still, Nagy offers a cautionary reminder to those who hype the power of A.I.: technology is only as good as the people who use it. “I think artificial intelligence is fantastic,” she adds. “The new software is fantastic. But if it gets into the wrong hands, it’s worth nothing — or worse, it does more damage. And again, who’s going to be left behind? The victims.” The same facial recognition and machine learning algorithms that help track down sex traffickers can also trawl through the oceans of our own personal data to draw conclusions about our moods, politics, sexual preferences, addictions, and other behaviors we’d rather not share — assuming they even get us right, which many algorithms fail to do. If A.I. tools are built off biased data sets, they’ll be biased in turn. Civil rights advocates have raised serious concerns about the use of facial recognition algorithms in identifying criminal suspects. This is especially true for minorities — research by Georgetown Law School estimated 117 million American adults are in facial recognition networks used by law enforcement, and that African Americans were most likely to be singled out. Some trafficking advocates simply bristle at bringing in machine learning to solve one of the most deeply human and emotionally intricate of crimes. They also feel that the Traffic Jams and TellFinders are missing the mark. “These tools are mostly a waste of very scarce resources,” says Jessica Hubley, a telling remark coming from the co-founder of a nonprofit, AnnieCannons, whose mission is training trafficking survivors in tech skills. Hubley argues that providing a solid path to legal employment changes the calculus more than busting traffickers, which too often leaves victims out on the streets vulnerable to the next predator. AnnieCannons graduates not only get good jobs, but they are also designing tech solutions they’d like to see, including a mobile app to help with restraining orders and a platform to crowdsource anonymous sexual assault reports.

# Biotech good/not so bad – inevitability debate

## Biotech inevitable – demand

#### Biotech development response to demand and successes in biotech applications

Evens, 22

[Ronald, biotechnology consultant and Adjunct Research Professor at Tufts University, "Biotechnology – A Continual Revolution in Product Development and Healthcare – 1st 20 Years versus 2nd 20 Years and Beyond", European Society of Medicine, 4/29/22, https://esmed.org/MRA/mra/article/view/2719/193546069, accessed 7/9/22, GDI-cc]

Indications for biotech products numbered 474 as of 12.31.2021, which have grown quite dramatically in last 12 years (see figure 2); 1st 20 years equals 104 indications vs 344 indications in 2nd 20 years. The reasons for such growth are manifold; first, the discovery and marketing of many new products for previously untreated diseases of course. Second, the advances in diagnostics have created subcategories of disease that respond differently to products, especially in oncology, such as, multiple genetic markers (positive or negative) in one disease, acute vs chronic disease, newly diagnosed vs advanced vs recurrent vs metastatic disease, tissue or cell location of disease (local vs invasive), multiple cell types in a tissue (e.g., squamous vs non-squamous, small cell vs non-small cell, 10-plus cell types in lymphoma). Third, multiple different treatment categories exist as well, such as induction vs maintenance, 1st - 2nd - 3rd - 4th lines of therapy, varied mechanisms of action vs same disease, and adverse event profiles. Biotech product indications are broad in the scope of diseases and can be represented by the number of indications per medical discipline, as demonstrated in table 3. Oncology presents by far the most indications [175], followed by infectious diseases [48], hematology [41], dermatology [34], and endocrinology [31], rounding out the top five medical disciplines. Biotech products dramatically overcame previously poorly and only symptomatic treatments to achieve pathophysiologic disease control, and also the first ever treatments for previously untreated diseases. A few examples follow; 1. Proteins, such as interferon-beta for multiple sclerosis, enzyme replacement therapy for incurable genetic diseases, such as, agalsidase beta for Fabry disease and elosulfase alfa for Morquio syndrome, darbepoetin for anemias in nephrology and oncology, factor eight recombinant proteins for Hemophilia A and B, etanercept for rheumatoid arthritis and psoriasis, aflibercept for acute macular degeneration, ovulatory failure with follitropin alfa; 2. Peptides for osteoporosis with teriparatide, diabetes with liraglutide; 3. Oligonucleotides (RNA inhibition) such as nusinersen for spinal muscle atrophy and golodirsen for Duchenne’s muscular dystrophy; 4. Vaccines for pneumococcal, herpes zoster, meningitis, and Covid-19 infections; 5. Monoclonal antibodies (over 100) for manifold immune and oncologic diseases (170 plus), vastly improving patient responses and disease control.

## Biotech inevitable – investment

### AT Ukraine war stop development

#### Biotech investment continues – and Ukraine war increases investment in elements of biotech like green tech

**Smith, 2022**

[Jonathan, “European biotech industry braces as war erupts in Ukraine” Labiotech, March 1, 2022 <https://www.labiotech.eu/trends-news/ukraine-war-europe-biotech/> GDI-TM]

Europe’s biotech industry braces itself Despite the bleak conditions in Ukraine, there might be a silver lining in the long term. European countries are presenting an increasingly united front against Russia’s actions in Ukraine, which could strengthen links between Europe’s various life sciences hubs, and improve the supply chains of medicines to Ukraine. In addition, the EU is considering lowering its dependence on Russian fossil fuels by increasing investments in renewable energy. This move could benefit biotech companies that aim to usher in a circular bioeconomy. For now, there are numerous ways that biotech companies can weather the current geopolitical storm. Many biotech players have signed a pledge to halt business activities with Russian companies and investors. According to Paule, biotech companies can help the situation in Ukraine by focusing on how to use their contacts and resources to bring medical supplies to those in need, in addition to providing work to Ukrainians coming to the rest of Europe. And, as Forte added, biotech startups should be confident that their efforts will bear fruit in the difficult situation, “even if at this stage there seems to be little space for optimism.”

## Biotech development now – general

#### Biotech development on an exponential rise – dramatic growth has occurred over the past 10 years

**Evens, 22**

[Ronald, biotechnology consultant and Adjunct Research Professor at Tufts University, "Biotechnology – A Continual Revolution in Product Development and Healthcare – 1st 20 Years versus 2nd 20 Years and Beyond", European Society of Medicine, 4/29/22, https://esmed.org/MRA/mra/article/view/2719/193546069, accessed 7/8/22, GDI-cc]

The 1960s and especially 1970s were the times for creating the core sciences of recombinant DNA technology and monoclonal antibodies that have and still do underpin biotechnology and also establishing the early biotechnology companies that produced the start of the biotechnology revolution in the 1980s. University based discoveries and innovations often have led to spin-out biotech companies. Success of the science and business of biotechnology in biopharma can be measured by the number and the variety of products, many indications with disease mitigations, companies (biotech and pharmaceutical), research & development, and product sales. In overview, biotechnology has demonstrated a substantial crescendo pattern of growth; first, with 518 products being marketed world-wide in United States (USA), Europe and Japan by December 2021 and 64 more products marketed in Europe and Japan; second, by 474 indications being approved by the USA Food & Drug Administration (FDA) and European Medicines Agency ; third, with 167 companies marketing products in United States (USA), Europe, and Japan in 2021; fourth, with over 420 companies conducting phase 3 clinical trials on 850 molecules for over 350 indications by 2021; and fifth, by $327 million in worldwide sales occurring in 2020. From the first 20 years - 1980 to 1999 period, versus the second 20 years - 2000 to 2019 period, and then up to the recent 2 years of 2020 & 2021, we first can observe in USA a substantial product growth from 11.6 products per year versus 23.5 per year versus 35 per year (see Figure 1), respectively. Secondly and similarly dramatic growth occurred in the indications for biotech products in 10 year intervals from 1.8 per year versus 7.7 per year versus 20.2 per year versus 45 per year (see figure 2), respectively. Third, growth in companies (pharma and biotech) launching new biotech products increased from #51 companies in first 20 years versus #179 in second 20 years versus #72 (only 2 years, 2020 and 2021), respectively. In Figure 3. the evolution of the number of biotechFDA approved products is presented with steady and remarkable growth over time from 1980 to 2021 in 5-year intervals, along with added indications being approved for already marketed products. A promising stream of future products is quite likely with over 850 biotech products in phase 3 clinical trials for 350 plus indications by 425 pharma and biotech companies.

## Biotech regulations now

### Biotech regulations harmonizing now

#### New biotech regulations remove some regulations for biotech

**Hoffman,** Biotechnology Regulatory Services USDA, **2021**

[Neil “Revisions to USDA biotechnology regulations: The SECURE rule” PNAS Vol 118 no 22 April 30 2021 <https://www.pnas.org/doi/10.1073/pnas.2004841118> GDI-TM]

With these goals of the 1992 CF Update, the 2017 Modernization of the CF, and Executive Order 13874 in mind, USDA recently revised its biotechnology regulations, now called the SECURE (Sustainable, Ecological, Consistent, Uniform, Responsible, Efficient) rule (15). The SECURE rule (15)

1)

establishes exemptions for plants modified by genetic engineering techniques where the modification could otherwise be achieved through conventional breeding techniques, ensuring that such plants are treated similarly to conventionally bred plants from a regulatory perspective, consistent with Scope principle 1 from the 1992 CF Update;

2)

uses a risk-based approach to determine whether an organism is regulated, rather than relying on whether the organism was developed using a plant pest consistent with Scope principle 2 in the 1992 CF Update; and

3)

provides a mechanism for a rapid initial review to efficiently distinguish plants developed using genetic engineering that do not pose plausible pathways to increased plant pest risk from those that do and thus require further evaluation, consistent with Scope principle 2 in the 1992 CF Update.

In contrast, under the former regulations the determination to regulate was based on whether a plant pest or plant pest sequence was used in the engineering process. USDA did not evaluate the risk posed by the modified plant or conduct a risk assessment of the product until a petition was submitted by a developer several years after the plant was subject to USDA oversight, thereby resulting in a substantial regulatory burden from the outset. The plant pest trigger provided a means of capturing most organisms developed using genetic engineering under the regulation because Agrobacterium (a plant pest) was used as a vector, or regulatory sequences from Agrobacterium or plant viruses were commonly used in genetic engineering. Over time the agency has learned that the presence of plant pest sequences or the use of a plant pest vector to modify a plant is unrelated to the properties (and risk) of the plant. Conversely, the plant pest trigger did not capture plants transformed by biolistics and with DNA lacking plant pest sequences. Thus, the plant pest trigger created a situation where many lower-risk plants developed using a plant pest were subject to regulation, while potentially higher-risk plants created without using a plant pest were not. By further harmonizing with the 1992 and 2017 CF Updates, the SECURE rule will provide more appropriate risk-based oversight of plants and other organisms developed using genetic engineering techniques. This is expected to reduce regulatory barriers, reduce regulatory costs, and stimulate innovation.

## Biotech investment now – private investment

### Biotech investment – small biotech companies

#### Biotech produces antibiotics – industry relies on small and medium biotech companies

**Rafiqi, 21**

[Fatema, Research Programme Manager for the Antimicrobial Resistance Benchmark, "Biotech’s antibiotic warriors need new reward system in superbug fight", Access to Medicine Foundation, 6/10/21, https://accesstomedicinefoundation.org/news/biotechs-antibiotic-warriors-need-new-reward-system-in-superbug-fight, accessed 7/8/22, GDI-cc]

Amsterdam, the Netherlands, 10 June 2021 - In the battle against drug-resistant bacteria, the world is more reliant than ever on a limited number of small and medium-sized biotechnology companies (SMEs), following the departure by many large drug companies from antibiotic development. Yet these smaller companies face a perilous financial journey that can often sink their attempts to bring life-saving new medicines to market, resulting in bankruptcies and cutbacks that further shrink the pool of new antibiotics available to humanity. New antibiotics and antifungals are urgently needed, due to rising rates of resistance. For example, the fungal superbug candida auris can be deadly, with the US Centers for Disease Control (CDC) reporting up to [90% of samples](https://www.cdc.gov/fungal/diseases/candidiasis/antifungal-resistant.html#:~:text=Antifungal%20resistance%20is%20an%20increasing,to%20the%20antifungal%20drug%20fluconazole.) showing resistance.

A new report from the Access to Medicine Foundation, drawing on new data and discussions with stakeholders, examines how SMEs are navigating the tough conditions in the antibiotic market. It concludes that fresh incentives are urgently needed to head off a medical catastrophe, including the adoption of innovative subscription-based models.

SMEs are now pivotal in driving innovation in new antimicrobial development, accounting for 75% of all late-stage antibiotics in the R&D pipeline. But the low returns of this business – both in the price paid and the volumes used – means survival is a struggle, even for some companies with the most promising products in the pipeline and those that have successfully developed products.

# Biotech good/not so bad – impacts

## Biodefense

#### A - Biotech creates effective biodefense – key elements improved through process of biotech development

**Berger, 19**

[Kavita, Associate Director of the Center for Science, Technology, and Security Policy at the American Association for the Advancement of Science, "Emerging and Enabling Technologies in Biodefense", National Library of Medicine, 3/31/19, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123622/, accessed 7/8/22, GDI-cc]

\*MCM = medical countermeasures

The emergence of new biotechnologies provides great promise for biodefense, especially for key objectives of biosurveillance and early warning, microbial forensics, risk and threat assessment, horizon scanning in biotechnology, and MCM development, scale-up, and delivery. Understanding and leveraging newly-developed capabilities afforded by emerging biotechnologies require knowledge about cutting-edge research and its real or proposed application(s) to analogous needs, the process through which biotechnologies advance, and the educational and research infrastructure that promotes multi-disciplinary science. When combined with knowledge about biodefense gaps that could be addressed through science and technology, creative scientists, engineers, and decision-makers can design research agendas or concepts based on the identified gaps and S&T needs, and that leverage emerging biotechnologies. Innovation in research and technology development are driven by sector-specific needs and the convergence of the physical, chemical, material, computer, engineering, and life sciences. Biotechnologies developed for other sectors could be applied to biodefense, especially if the individuals involved are able to innovate in concept design and development. Of all biodefense objectives, biosurveillance seems to have reaped the most benefit from emerging biotechnologies, specifically the integration and analysis of diverse clinical, biological, demographic, and other relevant data. More recently, scientists have begun applying synthetic biology, genomics, and microfluidics to development of new products and platforms for MCMs. Unlike these initiatives, investments in microbial forensics have been few, limiting its ability to leverage biotechnology advances for collecting and analyzing data. Looking to the future, emerging biotechnologies can provide new opportunities for enhancing biodefense by addressing capability gaps.

#### B – Risk of bioterrorism growing due to technological advances—mass death without a cure and biodefense

**Ord**, senior research fellow in philosophy at Oxford University, **2021**

[Toby, “Covid-19 has shown humanity how close we are to the edge,” The Guardian, March 23rd, https://www.theguardian.com/commentisfree/2021/mar/23/covid-19-humanity-resilience-climate-ai-pandemic, accessed 6/26/21, former GDI workshop student - AJ]

Technological progress since the Industrial Revolution has ultimately increased the risk of the most extreme events, putting humanity’s future at stake through nuclear war or climate breakdown. One technology that may pose the greatest threat this century is artificial intelligence (AI) – not the current crop of narrowly intelligent networks, but more mature systems with a general intelligence that surpasses our own. AI pioneers from Alan Turing to Stuart Russell have argued that unless we develop the means to control such systems or to align them with our values, we will find ourselves at their mercy.

By my estimation, the chances of such a risk causing an existential catastrophe in the next century are about one in six: like Russian roulette. If I’m even roughly right about the scale of these threats, then this is an unsustainable level of risk. We cannot survive many centuries without transforming our resilience.

The government’s recent integrated review highlighted the importance of these “catastrophic-impact threats”, paying attention to four of the most extreme risks; the threats from AI, global pandemics, the climate crisis and nuclear annihilation. It rightly noted the crucial role that AI systems will play in modern warfare, but was silent about the need to ensure that the AI systems we deploy are developed safely and aligned with human values. It underscored the likelihood of a successful biological attack in the coming years, but could have said more about the role science and technology can play in protecting us. And although it mentioned the threat of other countries increasing and diversifying their nuclear capabilities, the decision to expand the UK’s own nuclear arsenal is both disappointing and counterproductive.

To really transform our resilience to extreme risks, we need to go further. First, we must urgently address biosecurity. As well as the possibility of a new pandemic spilling over from animals, there is the even worse prospect of an engineered pandemic, designed by foreign states or non-state actors, with a combination of lethality, transmissibility, and vaccine resistance beyond any natural pathogen. With the rapid improvements in biotechnology, the number of parties who could create such a weapon is only growing.

## Extension – Biodefense

### Biodefense – vaccine development and advanced warnings

#### Investment in biotech creates biodefense – produces vaccine development and provides an advanced warning of biothreats through data sharing

**Berger, 19**

[Kavita, Associate Director of the Center for Science, Technology, and Security Policy at the American Association for the Advancement of Science, "Emerging and Enabling Technologies in Biodefense", National Library of Medicine, 3/31/19, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123622/, accessed 7/8/22, GDI-cc]

Biotechnologies provide critical capabilities in the defense against natural and man-made threats. In health, new scientific discoveries and platforms contribute to the development of vaccines and medicines against pathogens, such as influenza A virus or Bacillus anthracis. Researchers’ ability to understand the relationship between pathogens and their hosts provide the information needed to create targeted vaccines and medicines. Similarly, scientists have begun applying synthetic biology tools and concepts to vaccine development, hoping to reduce the time involved in creating a vaccine against an emerging infectious disease and enabling rapid response efforts. More recently, investments in additive bio-manufacturing have provided new opportunities to print human tissues and organs, which in some laboratories, are being used to study the effects of pharmaceutical candidates before testing in animals or people. In addition, advances in knowledge gained from neuroscience and behavioral sciences provides new opportunities to understand and identify clinical interventions to prevent or treat various psychological disorders, such as post-traumatic stress disorder after return from military conflict.

Beyond health efforts, governments are looking to the life sciences and biotechnology to assist in early warning of infectious disease events, forensics, decontamination of materials, and many other uses. Efforts to gain advanced warning of infectious disease events have leveraged new data analysis technologies (e.g., natural language processing, image analysis, and text analysis) to evaluate a variety of information, including environmental, ecological, genomic, physiological, and other relevant data. Efforts to promote longevity of materials and equipment have leveraged advances in synthetic biology. Efforts to enhance microbial forensics and attribution have leveraged advances in microbiology and improved data handing and sharing procedures between public health and law enforcement communities. Enabling this research and data sharing was a commitment by the U.S. government and international organizations to seek solutions for capability gaps in preventing, detecting, and responding to natural and/or man-made infectious disease events of international concern.

### Biodefense - surveillance and data

#### Biotech produces methods of biodefense to preserve national security – creates effective surveillance methods and flow of data

**Berger, 19**

[Kavita, Associate Director of the Center for Science, Technology, and Security Policy at the American Association for the Advancement of Science, "Emerging and Enabling Technologies in Biodefense", National Library of Medicine, 3/31/19, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123622/, accessed 7/8/22, GDI-cc]

Despite concerns about how advances in biotechnology could be applied to harm national security, these advances can enhance efforts to prevent, prepare for, and respond to incidents involving chemical and biological threats. For example, next generation sequencers and data analysis software allow scientists to collect information about host response following exposures to pathogens or hazardous chemicals, the microbiome that supports normal growth and functioning of the human body, the organisms in the environment, and many other molecules associated with the normal state of the human body and potential risk factors of exposure to chemical or biological hazards. These data can inform surveillance efforts to help determine whether and when a natural or man-made incident has occurred, aiding both detection of potentially harmful incidents and forensic analysis. In addition, the data may inform the development of vaccines, drugs, and diagnostic tools against chemical and biological agents [called medical countermeasures (MCMs)] [[57](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123622/#CR57)–[61](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123622/#CR61)]. Another examples include the use of synthetic genomics, which is the chemical synthesis of genomic DNA of organisms, as platform methods for rapid development of vaccines against epidemic pathogens. Synthetic biology is being used to create technology platforms for rapid MCM development against pathogens and for synthesis of pharmaceutical products. Similar technologies can be used to prevent, detect, and respond to incidents involving contamination or infection of animals and agriculturally-important plants. In addition, synthetic biology is being used to develop biological systems that “eat” nerve agent [[62](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123622/#CR62), [63](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123622/#CR63)], clean up contaminated materials [[61](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123622/#CR61)], and exert biocontrol in the environment [[64](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123622/#CR64), [65](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123622/#CR65)]. These efforts are being aided by advances in genome editing, laboratory automation, high-throughput experimental procedures, bioinformatics, and other technologies that improve repeatability and reduce human error during experimentation.

### Biodefense – MCM development

#### Application of biotech into MCM development creates effective biodefense – furthers scientific knowledge of threats and develops defense against pathogens

**Berger, 19**

[Kavita, Associate Director of the Center for Science, Technology, and Security Policy at the American Association for the Advancement of Science, "Emerging and Enabling Technologies in Biodefense", National Library of Medicine, 3/31/19, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123622/, accessed 7/8/22, GDI-cc]

\*\*MCM = medical countermeasure

Although the operational considerations for the MCM needs for the Department of Health and Human Services (HHS) and DoD differ, the early research and development studies do not differ dramatically by product end-use. Therefore, the relevant HHS and DoD offices established the Integrated Portfolio, poviding opportunities to co-manage investments in MCM research and development of common interest [[72](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123622/#CR72), [75](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123622/#CR75)].

These programs provide the structure within which new scientific research and technologies can be funded and leveraged for medical countermeasure development. Through a combination of funding programs and technology watch efforts, program managers support innovation in technology development and learn about existing biotechnologies that could be applied to MCM development. For example, the Defense Advanced Research Projects Agency (DARPA) has created several programs to generate the scientific knowledge needed to detect human infection from any pathogen, develop new technologies to conduct field diagnostics with little sample, and create platform methodologies for rapid development of vaccines against outbreak pathogens [[76](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123622/#CR76), [77](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123622/#CR77)]. Although the results of this research are expected to enhance military force protection against biological threats, the scientific discoveries and technologies may benefit development of MCMs for civilians.

Recognizing potential funding opportunities for MCM development, academic and industrial researchers have undertaken efforts to apply new knowledge and scientific approaches to MCM development. For example, in 2013, the J. Craig Venter Institute and Novartis described the rapid creation of influenza vaccines within a cell-free system, capitalizing on recent innovations in synthetic biology [[78](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123622/#CR78)]. More recently, scientists have used synthetic genomics (i.e., chemically-synthesized genomes) to generate hard-to-obtain pathogens, such as severe acute respiratory syndrome coronavirus [[79](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123622/#CR79), [80](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123622/#CR80)], or to develop candidate vaccine vectors against biological agents such as the recently-recreated horsepox virus [[81](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123622/#CR81)]. Still other scientists have conducted studies to develop research animals and conditions that reflect pathogen infection and onset of disease in humans [[70](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123622/#CR70), [82](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123622/#CR82)] or alternative approaches for studying product efficacy, such as the “human on a chip” [[83](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123622/#CR83)].

## Climate change

### 1nc/2ac

#### A - Tools of biotech used to slow climate change and address global food insecurity

**Kilaru,** American Association for the Advancement of Science (AAAS) science, technology and policy fellow, **and Peterson,** lead science advisor USDA Foreign Agricultural Service, **2022**

[Dr. Aruna and Dr. Chris, “Agricultural Biotechnology: A Vital Tool to Address Food Security and Climate Change” Agrilinks Team February 24, 2022 <https://www.agrilinks.org/post/agricultural-biotechnology-vital-tool-address-food-security-and-climate-change> GDI-TM]

Tools of agricultural biotechnology include modern breeding techniques, genetic engineering and genome editing. They may offer diverse, science-driven approaches to simultaneously alleviate the accelerating pace of both climate change and global food insecurity, while building on decades of using these products safely. Farmers can adopt an integrated set of tools, including biotech crops, that are climate resilient and can better withstand various stresses, including drought, heat and flooding. In addition, researchers are designing many traits with the goal of reducing greenhouse gas emissions and conserving water and land, while increasing yields (Figure 1). Ultimately, it is not enough to have good products that work. Country regulatory environments that allow these products to come to the market and public acceptance are also essential to our efforts in Feed the Future.

#### B - Climate change causes extinction

* Turns: war
* Disease
* Coop
* Environment

David Spratt and Ian T. Dunlop ’19, May. Research Director for Breakthrough National Centre for Climate Restoration, Melbourne; member of the Club of Rome. Formerly an international oil, gas and coal industry executive, chairman of the Australian Coal Association, chief executive of the Australian Institute of Company Directors, and chair of the Australian Greenhouse Office Experts Group on Emissions Trading 1998-2000, “Existential climate-related security risk: A scenario approach”, Breakthrough Policy Paper, <https://docs.wixstatic.com/ugd/148cb0_a1406e0143ac4c469196d3003bc1e687.pdf>

Even for 2°C of warming, more than a billion people may need to be relocated and In high-end scenarios, the scale of destruction is beyond our capacity to model, with a high likelihood of human civilisation coming to an end. 21 National security consequences: For pragmatic reasons associated with providing only a sketch of this scenario, we take the conclusion of the Age of Consequences ‘Severe’ 3°C scenario developed by a group of senior US national-security figures in 2007 as appropriate for our scenario too: Massive nonlinear events in the global environment give rise to massive nonlinear societal events. In this scenario, nations around the world will be overwhelmed by the scale of change and pernicious challenges, such as pandemic disease. The internal cohesion of nations will be under great stress, including in the United States, both as a result of a dramatic rise in migration and changes in agricultural patterns and water availability. The flooding of coastal communities around the world, especially in the Netherlands, the United States, South Asia, and China, has the potential to challenge regional and even national identities. Armed conflict between nations over resources, such as the Nile and its tributaries, is likely and nuclear war is possible. The social consequences range from increased religious fervor to outright chaos. In this scenario, climate change provokes a permanent shift in the relationship of humankind to nature’. (emphasis added)

## Extensions – see also Environment

## Environment – General

### 1nc/2ac

#### A - Biotech tools enhance biodiversity conservation, improving ag practices, reducing land use, pesticide use, reduce carbon emissions – expanded biotech benefits the environment

**GUERRERO, Alliance for Science, 2022**

[Sol, Alliance for Science based Boyce Thompson Institute, an independent nonprofit research institute that is also affiliated with Cornell University, “How biotech aids biodiversity” Alliance for Science FEBRUARY 17, 2022 <https://allianceforscience.cornell.edu/blog/2022/02/how-biotech-aids-biodiversity/> GDI-TM]

Agriculture is practiced in approximately 40 percent of the world’s landmass. By replacing natural ecosystems, it has become the largest terrestrial biome on our planet. Most of the land used to produce crops (~96 percent) is farmed using conventional methods but this trend is shifting. Since the first genetically modified (GM) plants — antibiotic resistant tobacco and petunia — were successfully created in the 1980s, GM/biotech crops have been the fastest adopted crop technology in the history of modern agriculture.

How GM crops benefit biodiversity

After so many years of production, there is ample scientific literature that demonstrates how GM crops have had a positive impact on biodiversity. Some include:

PROTECTING FARMLAND BIODIVERSITY

There is a substantial body of literature addressing the potential beneficial impacts of GM crops on the environment in the context of farmland diversity. GM crops preserve varietal diversity in many crops. For example, they can be engineered to resist insect pests, reducing the use of synthetic insecticides and resulting in higher insect biodiversity on farms when compared to planting similar conventional varieties and using synthetic insecticides.

REDUCING PESTICIDE USE

Modern biotechnology can help protect the environment from pesticide use. GM crops that are resistant to pests have significantly contributed to the reduction of insecticide sprays around the world. It is estimated insect-resistant crops reduced global pesticide use by 37 percent.

REDUCING TOXIC LEVELS IN HERBICIDE USE

Many GM crops produced through modern biotechnology have helped decrease the use of herbicides with acute (or short-term) toxicity and chronic (or long-term) toxicity.

DECREASING CO2 EMISSIONS

The use of some GM crops contributed to tens of millions of acres transitioning to zero-tillage. The reduction in tillage has produced a significant environmental benefit, resulting in 2.4 billion kg fewer carbon dioxide emissions. Moreover, the adoption of GM technology in corn, soybean and cotton reduced agricultural land and input use, saving 0.15 Gt of GHG emissions, equivalent to roughly one-eighth the emissions from automobiles in the US.

AVOIDING FARMLAND EXPANSION

Modern biotechnology can help produce more with less land. Higher yields on cultivated land could reduce the need for additional cropland expansion, thus preserving natural biodiversity. Without the productivity gains from GMOs during recent years, around 25 million hectares of additional farmland would have to be cultivated globally, in order to maintain current agricultural production levels. Farmland expansion is an important contributing factor to biodiversity loss and climate change.

ADDRESSING CLIMATE CHANGE

GM crops currently under development have produced evidence that if adopted they could contribute to climate change mitigation and adaptation. Drought-tolerant maize varieties have been reported to perform better than conventional varieties across several countries in eastern and southern Africa. Moreover, GM crops have been proposed as an important part of an integrated strategy to mitigate the effects of climate change, such as drought and potential damage of fall armyworm in Africa.

#### B - Pollution, biodiversity loss and anthropogenic climate change, are an existential threat and are rapidly accelerating

Sepkoski, ‘21

(David, professor of history at the University of Illinois at Urbana-Champaign, “The Anthropocene Is Overrated: The way we talk about climate change and our effect on the planet is all wrong--and increasingly dangerous,” Foreign Policy, Issue 240, Spring 2021, utexas-Gale In Context: Opposing Viewpoints, accessed 8/5/2021, Former GDI workshop student - ZW)

Welcome to the age of humans--the Anthropocene. Scientists, academics, public intellectuals, and policymakers have been using this term to describe a new geological epoch marking an unprecedented era of human impact on the natural environment. Beginning with the Industrial Revolution in the late 18th century, carrying through the development and testing of nuclear weapons, and peaking in recent decades with rapid global warming and the catastrophic depletion of the Earth's biodiversity, the Anthropocene is often framed as an existential threat to the survival of the human species. Like some of the great environmental catastrophes of the past--such as the mass extinction that wiped out the dinosaurs 65 million years ago--the footprint of human activity will be present in the geological record for millions of years to come. Or so the reasoning goes.

There is every reason to be alarmed about anthropogenic climate change, pollution, and biodiversity loss, all of which have been accelerating in recent decades and do pose existential threats. Warming trends could cause the collapse of Arctic and Antarctic ice sheets that would dramatically increase sea levels by dozens of feet by the end of this century. If that happens, say goodbye to New York City, San Francisco, Seattle, Mumbai, London, Istanbul, Dubai, St. Petersburg, Mumbai, and Beijing, to name just some of the most populous cities that would be drowned. Left unchecked, climate change would also involve ocean acidification (as the oceans absorb atmospheric carbon), terrible droughts and heat waves (with equatorial regions reaching unlivable temperatures for much of the year), air pollution at unbreathable levels in many major cities, and mass extinctions of plants and animals at levels not seen since some of the greatest geological catastrophes in the Earth's history--perhaps as severe as the "great dying" at the end of the Permian period some 250 million years ago, when as many as 96 percent of all living species may have died out. The resulting Earth from this catastrophe may become devoid not only of humans but perhaps of most complex life on land and in the seas.

### Extension – laundry list of environment protections

#### Biotech methods benefit the environment – biodiversity conservation, reduction of pollution and ag improvements

**GUERRERO, Alliance for Science, 2022**

[Sol, Alliance for Science based Boyce Thompson Institute, an independent nonprofit research institute that is also affiliated with Cornell University, “How biotech aids biodiversity” Alliance for Science FEBRUARY 17, 2022 <https://allianceforscience.cornell.edu/blog/2022/02/how-biotech-aids-biodiversity/> GDI-TM]

As the basis for food, housing, clothing, medicine, industrial raw material and potentially many more benefits to human well-being, biodiversity is crucial to our survival and economic development.

Numerous scientific studies show that the use of biotechnology in agriculture can help to protect biodiversity and stem its loss.

The main causes of biodiversity degradation are habitat/species loss, invasive species, over-exploitation, pollution and climate change. Biodiversity conservation has become a global concern requiring a comprehensive and integrated approach. There are different methods and strategies to conserve biodiversity, and biotechnology can play an important role in many of them.

Some biotechnology related methods can be applied directly to species of interest, for example, through cryopreservation of cells, tissues, gametes, oocytes, DNA samples, etc. stored in a genetic databank; a range of in vitro techniques (tissue culture, micropropagation and cloning); and artificial insemination, to mention a few.

Positive effects of biotechnology on the different levels of biodiversity by reduction of the drivers of biodiversity loss.

Other biotechnology related methods can be applied to entire ecosystems to address pollution or control invasive species. Since agricultural practices are the second largest contributor to biodiversity loss the changes made to agricultural systems through biotechnology can also have great positive impacts on biodiversity.

## Food/GMOs good – food supply/ solves hunger

### 1nc/2ac

#### A - Ag biotech improves nutrition and supply of food – empirics

**Gakpo 21**

(Joseph Opoku Gakpo, broadcast and online journalist on environmental issues with the Multimedia Group Limited in Ghana, master’s degree in communications studies from the University of Ghana, and is a member of the Ghana Association of Agricultural and Rural Development Journalists and the Ghana Journalists Association, “UN Food Systems Summit: Biotechnology key to meeting zero hunger goals” Alliance for Science, July 29th 2021, https://allianceforscience.cornell.edu/blog/2021/07/un-food-systems-summit-biotechnology-key-to-meeting-zero-hunger-goals/#:~:text=Agricultural%20biotechnology%20is%20a%20crucial,academics%20and%20civil%20society%20representatives, access 7/8/2022, GDI- TMK)

Agricultural biotechnology is a crucial tool for transforming global food systems to meet the United Nation’s goal of ensuring zero hunger by 2030, say some scientists, academics and civil society representatives. Evidence abounds that biotechnology has had a positive overall impact on agriculture in the areas where it has been employed, they say. If adopted more widely across the globe, it could be instrumental in meeting the UN’s Sustainable Development Goal (SDG) 2, which aims to end world hunger, boost nutrition and support agricultural sustainability within the next nine years. “GMO technology is working for farmers,” observed Arif Hossain, CEO of Farming Future Bangladesh. He cited the six-fold increase in income that farmers in Bangladesh have earned as a result of growing Bt eggplant, an important food crop genetically modified to resist the destructive fruit and shoot borer pest without the application of insecticides. More opportunities must be created for farmers to access crop biotechnology if the world’s food systems are to be transformed to meet the challenge of feeding the more than 811 million people who suffer hunger across the globe, he said. “The nutritional content and the beneficial element of staple foods like rice enriched with vitamins and minerals need to be emphasized and allowed to be grown so smallholder farmers can have access to that,” Hossain said. “We need to take immediate action and create enabling environments for people to have access.” It is high time for us all to come forward and allow people to innovate and use GM technology for food security and sustainability, he added. Given the world’s high population growth, limited land for agricultural production and ongoing COVID-19 pandemic, it will be more challenging to achieve the SDG on hunger, Hossain said, adding that all options that can help deal with food insecurity should be explored. Hossain made his comments during a Food Systems Summit independent dialogue organized by the Alliance for Science. The dialogue was one of thousands being held across the world ahead of the UN’s extraordinary global Food Systems Summit in September, where the future of the world’s food systems will be deliberated. The meeting was deemed necessary because the world currently is not on track to meet the zero-hunger target and other SDGs by 2030 unless drastic actions are taken. Participants will deliberate on and launch bold, new actions to help deliver progress on all 17 SDGs, each of which relies to some degree on the goal of achieving zero hunger. “There is a big role ag biotech can play in food systems transformation, especially the role of ag biotech in value addition to be able to get the best out of the crops,” Vitumbiko Chinoko, project manager of the Open Forum on Agricultural Biotechnology (OFAB), told the dialogue. He urged governments to invest more in the technology. “I’m looking at a future where we will invest our own money as African governments into ag biotechnology so we can own the technology,” Chinoko said. Agricultural economist Dr. Graham Brookes, director of PG Economics in the United Kingdom, told the dialogue that the adoption of GM crops between 1996 and 2018 produced an additional 824 million tonnes of food, feed and fiber worldwide. He said farmers earned an extra US$225 billion in income by growing GM crops during that same period, while reducing the use of agricultural pesticides by 8.6 percent, resulting in a 19 percent cut in associated environmental impacts. The technology also helped reduce carbon emissions equal to taking 15.3 million cars off the road. Because GM crops increase yields, if they had not been available during that time some 24.2 million extra hectares of land would have been destroyed to make way for the same amount of crop production, he noted. “The evidence after 23 years of widespread use is fairly consistent in showing there are socio-economic and environmental benefits of using the technology,” Brookes told the dialogue. André Tomas Vilela Hermann, founder of the Synthetic Biology Club in Brazil, told the dialogue that biotechnology helped move his country from the status of a net importer of food to net exporter. He said several ag biotechnologies are still under development which the world should accept if zero hunger is to be achieved by 2030.

#### b. Impact - Food insecurity leads to societal collapse—conflict and institutional breakdown, international spillover

**Richards, Lupton, and Allwood, 2021** (C.E., Civil Engineering Research Student, University of Cambridge, R.C., Lecturer in Mechanical Engineering at the University of Bath, and Professor of Engineering and the Environment at the University of Cambridge, “Re-framing the threat of global warming: an empirical causal loop diagram of climate change, food insecurity and societal collapse”, Climatic Change (2021) 164: 49, published 19 February 2021, <https://link.springer.com/content/pdf/10.1007/s10584-021-02957-w.pdf>, accessed 8/7/2021, Former GDI workshop student -GJack)

Walking through the CLD at a high-level, we can see how population growth and lifestyle emissions, influenced by institutional/demographic factors (e.g. emission reduction incen- tives), combine to directly drive climate change. Similarly, they indirectly drive climate change via consumer demand on food production, which produces emissions directly (e.g. ruminant livestock) and indirectly via industrial capital/output (e.g. processing factories). The environmental risk factors (e.g. extreme weather events) of climate change may cause losses of food production either directly (e.g. plant disease) or indirectly via agricultural input availability (e.g. loss of water source for irrigation). A country’s food availability is influenced by domestic food production and international food trade. Food accessibility is influenced by its food price, which responds to domestic (e.g. cost of food production and distribution) and international (e.g. international food price) markets, and institutional/demographic factors (e.g. food subsidies). Food utilization is influenced by infrastructure/services (e.g. education) and institutional/demographic factors (e.g. cultural traditions). Food insecurity is underpinned by these three pillars of food availability, food accessibility and food utilization. For a given country, food insecurity can drive natural mortality (i.e. starvation), conflict and migration, contributing to population loss, as well as economic shocks and socio-political instability, contributing to institutional breakdown, which exacerbates the risk of societal collapse.∂ Beyond a given country suffering increased natural mortality, famines (i.e. food insecurity) can place pressure on international humanitarian efforts (i.e. institutional risk factors). Conflict may occur domestically or internationally and can feedback to exacerbate food insecurity and institutional fragility (i.e. institutional risk factors). Potential mass emigration can increase pressure on food availability, natural resources and infrastructure/services in the destination nation, which can lead to socio-cultural tensions (i.e. institutional risk factors) that fuel conflict. Food insecurity can also directly contribute to institutional risk factors such as social unrest, political instability and economic inequality, which increase the risk of societal collapse due to institutional breakdown, that may also cascade internationally. While already fragile states are expected to be hit the worst directly, these insights reveal the indirect ramifications of climate change on our globalised society (Kemp 2020), with serious conse- quences for humanity’s ‘existential security’ (Sears 2020).

### Extensions – nutrition

#### Biotechnology can help create foods to solve global nutrition issues.

**Jamil, no date**

(Kaiser Jamil, internationally renowned biotechnologist and president of the Third World Organization for Women in Science, “Biotechnology – A Solution to Hunger?” United Nation UN Chronicle, no date, https://www.un.org/en/chronicle/article/biotechnology-solution-hunger, accessed 7/8/2022, GDI- TMK)

Nevertheless, the potential advantages that biotechnology can confer across a wide range of agricultural applications are in areas such as livestock management, storage of agricultural products and sustaining current crop yields, while reducing the use of fertilizers, herbicides and pesticides. The real challenge is whether we are smart enough to harness the benefits of biotechnological solutions. But what are these solutions? Biotechnology offers a very promising alternative to synthetic foods and an improvement on conventional plant-breeding technologies. Combined with other advanced agricultural technologies, it offers an exciting and environmentally responsible way to meet consumer demand for sustainable agriculture. When the benefits of GM crops reach small and marginal farmers, more Green Revolutions may become a reality. Combating Hunger and Malnutrition Malnutrition is the related term in medicine for hunger. The most recent estimate of the Food and Agriculture Organization says that 854 million people worldwide are undernourished. This is 12.6 per cent of 6.6 billion people in the world. Many of the 854 million that are undernourished, children being the most visible victims, live in developing countries. Undernutrition magnifies the impact of every disease, including measles and malaria. One example tells us how biotechnology can contribute to combating global hunger and malnutrition. Golden Rice Approximately 140 million children in low-income groups in 118 countries, especially in Africa and South-East Asia, are deficient in Vitamin A. This situation has compounded into a public health challenge. The World Health Organization reports that an estimated 250,000 to 500,000 Vitamin A-deficient children become blind every year, half of them dying within 12 months of losing their sight. Golden Rice, created by researchers in Germany and Switzerland, contains three new genes -- two from the daffodil and one from a bacterium -- that helps it to produce provitamin A. This rice is available as a possible option for mass distribution, in part due to the waiving of patent rights by biotechnology companies. This is just one among the hundreds of new biotech products, which point to the contributions of biotechnology to society.

## Answer to answer blocks

### AT “you’re evidence assumes ag biotech not NATO biotech”

#### Tools are tools: the foundational concepts of biotech apply across sectors – stimulation of investment and innovation spills-over

## Answers to Biotech Bad turns

### AT bioweapons – see biodefense

### No super-soldiers - Limited tech

#### Despite aspirations, limited tech capacity to build super soldiers

**Poole, 2021**

[Thom, “The myth and reality of the super soldier” BBC8 February 2021 <https://www.bbc.com/news/world-55905354> GDI-TM]

Having a super soldier in the ranks is a tantalising prospect for militaries - imagine a soldier who could withstand pain, extreme cold or the need to sleep. But as American attempts to build "Iron Man" show, technological restraint can drag ambition down to earth. A 2019 paper from two US academics said that China's military was "actively exploring" such techniques as gene editing, exoskeletons and human-machine collaboration. The report was based primarily on comments from Chinese military strategists. One of the authors, Elsa Kania, was sceptical about Mr Ratcliffe's comments. "It's important to understand what the Chinese military is discussing and aspiring to actualise, but also to recognise the distance between those ambitions to the reality of where technology is at this moment," said Ms Kania, a senior fellow at the Center for a New American Security. "Even though militaries around the world may have quite a lot of interest in the possibility of super soldiers... at the end of the day, what is feasible within science does impose a constraint on on any actor that is trying to try to push the frontiers."

### No gene drive based extinction

#### No risk of gene drive based extinction – resistance proves

**O’Loughlin, Target Malaria, 2019**

[Samantha, “GENE DRIVE MYTH-BUSTING: GENE DRIVE WILL CAUSE SPECIES EXTINCTIONS” Outreach Network for Gene Drive Research, [The Network’s members are researchers and organisations working on gene drive research for public interest, organisations involved in outreach, stakeholder engagement and other relevant fields, as well as funders or supporters of these activities including Current members of the Network are Island Conservation (a Genetic Biocontrol of Invasive Rodents partner), Target Malaria, the Bill & Melinda Gates Foundation, Ifakara Health Institute, the UCI Malaria Initiative, McMaster Institute on Ethics & Policy for Innovation, Malaria No More, the Pirbright Institute, the Insect Genetics Group, Hebrew University of Jerusalem, the Liverpool School of Tropical Medicine, Revive & Restore, Dr. Daniel Maeda, Department of Molecular Biology and Biotechnology, University of Dar es Salaam, Akbari Lab at UCSD, Advanced Conservation Strategies and Conservation X Labs.] July 15 2019 <https://genedrivenetwork.org/blog/27-gene-drive-myth-busting-gene-drive-will-cause-species-extinctions> GDI-TM]

Gene drive can become a useful tool to reduce biodiversity loss and control vector-borne diseases. In the process of researching gene drive, we’re not only looking at the benefits (i.e. what it could do that would be useful) but also we’re trying to understand the potentials risks involved, including the impacts they may have on other species. So could a gene drive organism lead to a species’ extinction? As I mentioned in the post Gene drive myth-busting: Gene drive will spread globally, gene drives can be designed so that they will not spread through an entire species. There are also regulations and guidance in place to make sure gene drive organisms will be kept in laboratories and tested thoroughly before they would be considered for use in the environment. Gene drives that are being developed with the aim of spreading and reducing the numbers of a species (such as mosquitoes) could, in theory, result in local extinctions of the target species, but computer models show that there is a very low likelihood that gene drive could crash an entire species. This is due to factors such as barriers to spatial spread, differences in fitness of gene drive carrying individuals (compared to the wild type), and the eventual development of resistance. In the case of malaria, a common misconception that I have heard is that we are trying to eradicate mosquitoes. In fact, we are able to target a gene drive so that it only affects a few species of malaria carrying mosquitoes (and leaves all the many other mosquito species alone). The aim is to reduce their numbers to a low level so that the disease transmission cycle is broken. Eradicating malaria does not require eradicating the mosquitoes that transmit it.

# Biotech bad/not so good – inevitability debate

## Biotech not inevitable

### 1nc - Ukraine war disruption

#### Ukraine war disrupt supplies and research studies globally

**Wechsler, 2022**

[Jill, Washington editor Pharmaceutical Technology, “Ukraine Invasion Challenges Biopharma Research and Operations” Pharmatech March 11 2022 <https://www.pharmtech.com/view/ukraine-invasion-challenges-biopharma-research-and-operations> GDI-TM]

A major concern is how the invasion threatens to limit or halt clinical trials for drugs and biologics in both Ukraine and Russia, often cutting off research programs that enable patients with critical conditions to access advanced therapies. Ukraine-based drug companies and clinical trial sites have all but collapsed, as the Russian invasion has destroyed hospitals and research facilities. And biopharma companies are halting enrollment in many clinical trials in Russia, as the outlook continues to deteriorate. Analyses by Clinical Trials Arena and others document a sizeable number of research programs had been underway in those nations, many part of global research programs. San Francisco-based Tricida pharma, for example, recently acknowledged that the horrifying situation in Ukraine prompted it to delay expectations for clinical trial results for its chronic kidney disease drug candidate veverimer. Many clinical trials in the region, though, involve approved drugs seeking broader markets for therapies already available in the United States. Russia’s actions are slated to have a visible impact on pharmaceutical and vaccine production in India, where vaccine makers have extensive contracts to produce Russia’s Sputnik V COVID-19 vaccine for global distribution. India’s Dr. Reddy’s Laboratories, Serum Institute of India, and Hetero are leading distributors for the Sputnik vaccine, according to press reports. But Sputnik production has been slow and far below earlier expectations, even before the Ukraine crisis, as the Russian product gained only limited market acceptance. The situation is unlikely to change, as efforts by Russia to gain approval from the World Health Organization (WHO) for its Sputnik vaccine appear to be on hold. In addition, analysts anticipate supply disruptions and price increases for certain raw materials and supplies imported from Russia. Rising prices in oil and natural gas could boost the cost of certain plastics used in syringes and medical bottles. And the higher cost of transportation may curb access to certain materials over the long term, further heightening efforts to boost US production of medical supplies and products.

### Extensions – disruption

#### Ukraine war disrupting European biotech development – multiple elements

**Smith, 2022**

[Jonathan, “European biotech industry braces as war erupts in Ukraine” Labiotech, March 1, 2022 <https://www.labiotech.eu/trends-news/ukraine-war-europe-biotech/> GDI-TM]

Europe has been blindsided by its biggest war in decades with Russia’s invasion of Ukraine. Amid a raging humanitarian crisis, the biotech industry is preparing for increasing economic uncertainty, cyber threats, and clinical trial disruptions. The invasion of Ukraine by Russian forces last week caused a widespread outcry from the European community. The geopolitical landscape has undergone a historic shift and the tragic consequences of the event are rippling out to the European biotech industry. “The conflict in Ukraine is above all an enormous and deplorable shock to all of us,” said Miguel Forte, CEO of the Belgian regenerative medicine specialist Bone Therapeutics. “Our thoughts should go for those people, both in Ukraine and Russia, directly affected by reckless and irresponsible leadership.” The crisis has many facets and the biotech industry in Europe is preparing itself for challenges on a number of fronts. The human crisis The human cost of the invasion is expected to be heavy, with deaths and injuries from the conflict currently numbering in the hundreds, and a growing number of refugees moving west. The supply of lifesaving medications to and from the region are already being disrupted; the World Health Organization recently reported an urgent shortage of oxygen for use in healthcare in Ukraine. Another factor at play is the clamping down on air travel and shipments to and from Russian companies. “The primary and immediate consequences will be affecting Ukraine, but the impact could also likely be felt in Russia and for the Russian population,” said Forte. He added that other countries could be hit indirectly by the chaos. For life science companies, the impact will be strong in countries close to the epicenter of the conflict, including the Baltic states and Eastern European nations. These countries are facing uncertainty from the neighboring crisis, and many resident companies have employees and close contacts in Ukraine. In the Lithuanian life sciences industry, there are “companies that have business units, collaborations, and clients in Ukraine, which now has stopped,” said Monika Paule, CEO of the Lithuanian gene editing specialist CasZyme. “Companies are willing to relocate their employees, move collaborations to other countries, but all hope to get back to operations in Ukraine when the conflict is over.” While countries close to the conflict face large challenges, Paule sees life science companies in these regions also playing a strong role in alleviating the situation. “The sector is ready to help Ukraine by all means during and after the conflict either with medical supplies or bringing business activities back to the country,” she said. Clinical trials caught in the middle European biotech companies now face delays to clinical trials that are being run in Ukraine and Russia. The two countries have increasingly contributed to international studies over the last 10 years thanks to easy access to patient populations; Forte told me there are currently about 500 ongoing studies in Ukraine and over three times more in Russia. The ability of the sponsors, contract research organizations, and suppliers to keep going during the invasion is limited. “We can expect centers in Ukraine to shut down immediately to protect its staff and patients,” said Antoine Papiernik, Managing Partner of the investment firm Sofinnova Partners. “For Russian centers, the integrity of data from those sites might be at stake, and trials that are reliant on those sites will likely be affected.”

#### War and sanctions impact biotech investment – limited resources

**Smith, 2022**

[Jonathan, “European biotech industry braces as war erupts in Ukraine” Labiotech, March 1, 2022 <https://www.labiotech.eu/trends-news/ukraine-war-europe-biotech/> GDI-TM]

Financial consequences threaten biotech stocks In addition to the human tragedy caused by the events in Ukraine, financial aftershocks are expected. Many European nations have launched a volley of sanctions against Russia and its ally Belarus. These include bans on investments flowing to Russia-based banking and oil industries in addition to the removal of some Russian banks from SWIFT, the international financial transactions system. The current conflict and resulting sanctions on Russia could have direct and psychological repercussions on the overall business environment in Europe and scare off already risk-averse investors from the biotech scene. Forte sees less impact on early-stage private investment, but bad news for public biotech firms and life sciences companies at later stages of drug development. This blow comes as biotech stocks are already in an anemic situation due in part to inflation fears. “It was already tough in Europe since the beginning of the year, and it might worsen even more,” said Bertrand Delsuc, founder of the business intelligence firm Biotech Radar. “Cash is king, more than ever.” Nonetheless, Papiernik is confident that the biotech industry can pull through. “Biotech has, in the past, demonstrated resilience compared to many other industries,” said Papiernik. “Protecting human lives in the immediate term remains the priority, but I hope we can also preserve the infrastructure enabling us to develop drugs that will help patients in need over the long term.”

### Extensions - Cyber threats – disrupt development

#### Cyber threats target biotech and life sciences – increased risk because of war in Ukraine

**Smith, 2022**

[Jonathan, “European biotech industry braces as war erupts in Ukraine” Labiotech, March 1, 2022 <https://www.labiotech.eu/trends-news/ukraine-war-europe-biotech/> GDI-TM]

Cyberthreats to life sciences grow Part of the modern military arsenal is cyberattacks, and cyber threats are growing as Europe and the US slap economic sanctions on Russia. “Several cybersecurity agencies and government bodies have warned about Russia’s ability to retaliate asymmetrically through cyber means,” said Charles Fracchia, CEO of the US firm BioBright. “This means that any sectors of the EU, NATO, and the US economy are likely to be targets, including critical sectors such as banking, healthcare, and life sciences. In life sciences, the threat is probably highest for critical operations such as vaccine manufacturing, biomanufacturing more broadly, and large clinical centers.” Life sciences companies have been caught in the crossfire in the past; the US big pharma MSD lost over €1B in 2017 when it was hit by malware known as ‘notPetya,’ designed by Russia to target Ukraine. It took until January 2022 for MSD to claw back damage payments from insurers. “The notPetya attack was ostensibly not targeted at [MSD], and yet, it had this enormous effect, thousands of miles away,” said Fracchia. “[MSD] was big enough to withstand this, but it is clear that our industry could not withstand a targeted attack, to say nothing of the smaller biotech’s ability to survive altogether.” To endure pressing threats from cyberattacks, biotech companies are advised to assess their security measures and keep them up to date.

## Biotech Regulations – limited now

### Limited biotech regulation – GMOs

#### Relaxing regulations increase ability to modify plants without government oversigh

**Stokstad, 2020**

[Erik, “United States relaxes rules for biotech crops” Science Magazine, May 18 2020 <https://www.science.org/content/article/united-states-relaxes-rules-biotech-crops> gdi-tm]

A major change to U.S. regulation of biotech will exempt some gene-edited plants from government oversight. The new policy, published in the Federal Register today, also calls for automatic approval of variations of established kinds of genetically modified (GM) crops, easing their path to market. Industry groups are welcoming the new rule, whereas opponents are decrying the reduction of government oversight. "The main good thing is that it will allow certain aspects of gene editing to move forward," says Kent Bradford, a plant geneticist at the University of California, Davis. If researchers use gene editing to design a plant that could have been bred conventionally, the new plant will be exempt from regulation. But anything else—such as moving a gene between species or rewiring metabolism—will still require a regulatory review. The gist of the shift is that the U.S. Department of Agriculture's (USDA's) Animal and Plant Health Inspection Service (APHIS) will now focus on new traits themselves rather than the technology used to create them, a change of approach that plant scientists have long wanted. Several reviews by the National Academy of Sciences have concluded that the risk that GM plants will become weeds is generally low, and that molecular tools typically don't pose new risks compared with traditional plant breeding techniques. The change to the USDA regulations began during the Obama administration. The Trump administration released draft rules in January 2017, then withdrew them 9 months later. (In its new rule, USDA says it received comments that the previous version would be "too burdensome and had the potential to stifle innovation.") Last summer, USDA released a revised rule for public comment, which it has now finalized. An engineered plant won't be regulated if it contains minor changes—a change to a pair of amino acid bases or a deletion of a chunk of DNA—that would create a trait that could have been made through traditional breeding. For example, molecular biologists can snip disease resistance genes from various parts of a plant's genome and gather them into one stretch of DNA, allowing breeders to easily incorporate all the genes into one variety. The end product will be the same as what might be created by breeders, but gene editing can save years of effort, Bradford says. "This makes everything hugely easier." But he's frustrated that the exemption doesn't cover more substantive changes or moving genes between closely related plants, such as peppers and tomatoes, which can't be crossed with conventional breeding. Another change will make it easier to create minor variations of GM crops, such as tailoring them for different climates. Before, companies had to ask APHIS to evaluate the risk of any new GM crop they wished to commercialize, even if it had been altered in the same way as crops already approved. Now, APHIS won't regulate new varieties of an already approved GM crop.

### Extension – limited notification requirement in US

#### No requirement to inform public of gmos if the organism doesn’t fall under guidelines

**Stokstad, 2020**

[Erik, “United States relaxes rules for biotech crops” Science Magazine, May 18 2020 <https://www.science.org/content/article/united-states-relaxes-rules-biotech-crops> gdi-tm]

Some groups are concerned that companies won't have to notify USDA of biotech crops they will bring to market that are exempt from regulation. "The result is that government regulators and the public will have no idea what products will enter the market and whether those products appropriately qualified for an exemption from oversight," Gregory Jaffe of the Center for Science in the Public Interest said in a statement.

# Biotech bad – impact debate

## Accidental release – viruses

### 1nc/2ac

#### Expanded investment in biotech and DNA labs increase risk of virus release from lab

**Piper, 2022**

[Kelsay, “Why experts are terrified of a human-made pandemic — and what we can do to stop it” VOX, Apr 5, 2022, <https://www.vox.com/22937531/virus-lab-safety-pandemic-prevention> GDI-TM]

Decades ago, when the world first agreed on the norms and guidelines in the Biological Weapons Convention (BWC), designing and producing biological weapons was expensive and difficult. The Soviet Union had a large program, which is suspected to have led to the accidental release of at least one influenza virus that caused tens of thousands of deaths. But the Soviets seem to have never finalized anything deadlier than what nature came up with. Terrorist groups engaged in biological terrorism — like the Aum Shinrikyo cult, which launched a botched bioattack in Japan in 1993 — have so far largely been unable to improve on anthrax, a naturally occurring pathogen that is deadly to those who inhale it but isn’t contagious and won’t circulate the globe the way a pandemic disease can. But our ability to engineer viruses has grown by leaps and bounds in recent years, thanks in part to the rapidly falling price of DNA sequencing and DNA synthesis technologies. Those advances have opened the door to innovations in medicine, but they also present a challenge: Viruses as deadly and disruptive as Covid-19, or potentially much worse, are going to be possible to produce in labs worldwide soon, if not right now. To prevent pandemics that could be far worse than Covid-19, the world has to dramatically change our approach to managing global biological risks. “Amateur biologists can now accomplish feats that would have been impossible until recently for even the foremost experts in top-of-the-line laboratories,” argued Barry Pavel, a national security policy director at the Atlantic Council, and Atlantic Council co-author Vikram Venkatram. Avoiding a catastrophe in the coming decades will require us to take the risks of human-caused pandemics far more seriously, by doing everything from changing how we do research to making it harder for people to “print” themselves a copy of a deadly virus. Covid-19 was a warning shot for how fast a pandemic disease can spread around the world, and how ill-equipped we are to protect ourselves from a truly killer virus. If the world takes that warning shot seriously, we can insulate ourselves against the next pandemic, be it naturally occurring or human-made. With the right steps, we could even make ourselves “highly resistant if not immune to human-targeted biological threats,” MIT biologist Kevin Esvelt told me. But if we ignore the threat, the consequences could be devastating. Lab origins of pathogens, explained It isn’t known for certain whether the virus that caused Covid-19 was an accidental release from the Wuhan Institute of Virology (WIV), which was studying similar coronaviruses, or a far more common “zoonotic spillover” from an animal in the wild. An analysis by the US intelligence community found both possibilities plausible. A pair of preprint studies published in 2022 pointed toward a live animal market in Wuhan as the origin of the first outbreak. And recent reporting in Vanity Fair spotlighted risky and reckless research modifying coronaviruses in the lab to study whether they would infect humans more easily, and detailed how the scientists conducting such research closed ranks to ensure their work was not blamed for the pandemic. The reality is we may never know for sure. It can take years to conclusively trace back a zoonotic disease to its animal source, and China has made it clear it won’t cooperate with further investigations that could clarify any role WIV research may have played in Covid’s origin, however inadvertently. Whatever chain of events caused Covid-19, we already know that infectious disease outbreaks can originate in a lab. In 1978, a year after the final reported cases of smallpox in the wild, a lab leak caused an outbreak in the UK. Photographer Janet Parker died, while her mother got a mild case and recovered; more than 500 people who’d been exposed were vaccinated. (Smallpox vaccination can protect against smallpox even after an exposure.) Only that quick, large-scale response prevented what could have been a full-blown recurrence of the once-extinct disease. That’s not our only close brush with the return of smallpox, a disease that killed an estimated 300 million people in the 20th century alone. Six unsecured smallpox vials were discovered sitting in a refrigerator in the US National Institutes of Health (NIH) in 2014, having been forgotten there for decades among 327 vials of various diseases and other substances. One of the vials had been compromised, the FDA found — thankfully not one of the ones containing smallpox or another deadly disease. Other diseases have been at the center of similar lab mishaps. In March 2014, a Centers for Disease Control and Prevention (CDC) researcher in Atlanta accidentally contaminated a vial of a fairly harmless bird flu with a far deadlier strain. The contaminated virus was then shipped to at least two different agricultural labs. One noticed the mistake when their chickens sickened and died, while the other was not notified for more than a month. The mistake was communicated to CDC leadership only when the CDC conducted an extensive investigation in the aftermath of a different mistake — the potential exposure of 75 federal employees to live anthrax, after a lab that was supposed to inactivate the anthrax samples accidentally prepared activated ones. After SARS emerged in 2003, there were six separate incidents of SARS infections resulting from lab leaks. Meanwhile, last December, a researcher in Taiwan caught Covid-19 at a moment when the island had been successfully suppressing outbreaks, going without a domestic case for more than a month. Retracing her steps, Taiwan authorities suspected she’d caught the virus from a bite by an infected mouse in a high-security biology lab. “The fact is that laboratory accidents are not rare in life sciences,” former Sen. Joe Lieberman told the bipartisan Commission on Biodefense this March. “As countries throughout the world build additional laboratories to conduct research on highly infectious and deadly pathogens, it’s clear that the pace of laboratory accidents will naturally increase.

### Extensions – release risk/unintended consequences

#### Biotech labs risk release and unintended consequences of gene drives spread indefinitely and accidentally

Langer and Sharma, 20

[Ronit, Fellow in the technology and international affairs programat the Carnigie Endowment, and Shruti, senior research analyst with the Technology and Society Program at Carnegie India, "The Blessing and Curse of Biotechnology: A Primer on Biosafety and Biosecurity", Carnegie Endowment for International Peace, 11/20/20, https://carnegieendowment.org/2020/11/20/blessing-and-curse-of-biotechnology-primer-on-biosafety-and-biosecurity-pub-83252, accessed 7/9/22, GDI-cc]

Safety concerns extend beyond pathogens that may escape from research laboratories. Genetically engineered organisms that are introduced into a natural environment for beneficial purposes can also sometimes have unintended consequences. For example, although CRISPR/Cas9-enabled gene drives have the potential to eradicate vector-borne diseases, tackle invasive species, and control pests that target crops, the self-propagating nature of gene drives and the possibility that they could either spread indefinitely or accidently manipulate nontargeted species have raised concerns among regulators.

Similar experimental techniques, like sterilizing insects en masse, have been conducted in the past. One technique involves the mass sterilization of a targeted pest, such as fruit flies, using irradiation. Scientists advocating for gene drives argue that irradiation can cause random mutations, which might also have unintentional effects on the environment. Such off-target mutations can be avoided using gene drive technology that relies on genomic information obtained through reliable DNA sequencing tools. Although the technology has immense beneficial applications, it is important to update existing regulations and initiate public discourse on the benefits and the risks of this emerging technology

## Bioweapons – general

### 1nc/2ac

#### A - Biotech used for bioweapons – open source access to information increases risk of terror groups weaponizing biotech

Langer and Sharma, 20

[Ronit, Fellow in the technology and international affairs programat the Carnigie Endowment, and Shruti, senior research analyst with the Technology and Society Program at Carnegie India, "The Blessing and Curse of Biotechnology: A Primer on Biosafety and Biosecurity", Carnegie Endowment for International Peace, 11/20/20, https://carnegieendowment.org/2020/11/20/blessing-and-curse-of-biotechnology-primer-on-biosafety-and-biosecurity-pub-83252, accessed 7/9/22, GDI-cc]

Recent advances in synthetic biology, a technology that can be used to artificially create organisms in labs, carry the foreboding potential to develop biological weapons. Moreover, the emergence of the DIY community and the open-source nature of this movement have sparked concerns that terrorists could easily acquire the information needed to weaponize biotechnology, although none of these DIY groups have exhibited any nefarious intentions. Nefarious actors who previously acquired pathogens from a lab or from nature with the intention of developing a bioweapon can now either order DNA fragments online and assemble them to create dangerous pathogens or synthesize lethal pathogens from scratch using genomic information available online. Moreover, such actors can leverage vulnerabilities in the cyber defenses of labs and private companies to gain access to sensitive information that is not publicly available online. To better understand the security threats emerging from recent developments in biotechnology, it is worthwhile to return to the aforementioned hypothetical Ebola scenario. Imagine for a moment that the researchers involved, in collaboration with an editor at an esteemed journal, decided that they would publish a redacted version of the methods and the results section of their research due to security concerns. A month after the paper was published, the lab noticed unusual activity on their servers. The lab immediately reported the incident to the university’s information technology department. The department contacted local law enforcement officials, and together they traced the hack to a suspected terrorist organization. The group was trying to gain access to the methodology that led to the accidental creation of a more virulent Ebola strain so as to launch a deliberate biological attack. Law enforcement put DNA synthesis companies on high alert for any orders that closely aligned with research on the Ebola virus or other high-risk pathogens. Thankfully, a company was able to flag an order and law enforcement was able to cooperate with local officials to shut down the unauthorized lab before it began creating and releasing harmful products. In reality, individuals have at times tried to acquire deadly pathogens and other sensitive biological information. For example, two Canadians were arrested in the city of Buffalo, New York in 1984 after they were suspected of illegally acquiring and smuggling strains of botulism and tetanus to Canada. The Japanese cult Aum Shinrikyo made unsuccessful attempts in 1995 to acquire strains of Ebola from Central Africa to develop the group’s biological weapons program. More recently, two Chinese hackers were indicted in the United States for seeking to obtain intellectual property related to coronavirus treatments and vaccines. Similar incidents were reported in Spain; allegedly Chinese hackers were trying to steal data from Spanish labs conducting vaccine research. In addition to strategically embedding members into research organizations to acquire these deadly pathogens, some terrorist organizations also have sought to rely on lab insiders to either develop biological weapons or grant access to organisms or sensitive information. For example, a Malaysian scientist tried to develop anthrax weapons for Osama bin Laden, the founder of al-Qaeda. While most countries have national guidelines for handling safety and security threats, the examples described above highlight the global implications of such threats. It is therefore important to evaluate global best practices, treaties, and conventions that deal with such risks and devise strategies to update these safeguards to govern dual-use applications of emerging biotechnologies.

#### b. Bioweapons use bad – and independently, Biotech based attacks are an existential risk

Bryce 20 (Emma, Live Science Contributor, “What could drive humans to extinction?” Live Science, 7/25/20, <https://www.livescience.com/human-extinction-causes.html>, Accessed 7/15/21, former GDI workshop student JMoore)

Pandemics

The misuse of biotechnology is another existential risk that keeps researchers up at night. This is technology that harnesses biology to make new products. One in particular concerns Cassidy Nelson: the abuse of biotechnology to engineer deadly, quick-spreading pathogens. "I worry about a whole range of different pandemic scenarios. But I do think the ones that could be man-made are possibly the greatest threat we could have from biology this century," she said.

As acting co-lead of the biosecurity team at the Future of Humanity Institute at the University of Oxford in the United Kingdom, Nelson researches biosecurity issues that face humanity, such as new infectious diseases, pandemics and biological weapons. She recognizes that a pathogen that's been specifically engineered to be as contagious and deadly as possible could be far more damaging than a natural pathogen, potentially dispatching large swathes of Earth's population in limited time. "Nature is pretty phenomenal at coming up with pathogens through natural selection. It's terrible when it does. But it doesn't have this kind of direct 'intent,'" Nelson explained. "My concern would be if you had a bad actor who intentionally tried to design a pathogen to have as much negative impact as possible, through how contagious it was, and how deadly it was.”

### Extension - Unique risk of bioterror – tech access key

#### Improving cost effectiveness of tech expands access to engineering that risks virus escape

**Piper, 2022**

[Kelsay, “Why experts are terrified of a human-made pandemic — and what we can do to stop it” VOX, Apr 5, 2022, <https://www.vox.com/22937531/virus-lab-safety-pandemic-prevention> GDI-TM]

Alongside the near certainty that there will be more lab escapes in the future, engineering the viruses that could conceivably cause a pandemic if they escaped is getting cheaper and easier. That means it’s now possible for a single lab or small group to conceivably cause mass destruction across the whole world, either deliberately or by accident.

“Potential large-scale effects of attempted bioterrorism have been mitigated in the past by terrorists’ lack of expertise, and the inherent challenge of using biotechnology to make and release dangerous pathogens. Now, as people gain greater access to this technology and it becomes easier to use, the challenge is easing,” Pavel argues. The result? “Incidents of bioterrorism soon will become more prevalent.”

### Extension - Biotech bad – info hazard

#### Biotech advances outpacing regulations – increase risk of information hazard even if they win controls over the tech itself – even Bostrum agrees

**Piper, 2022**

[Kelsay, “Why experts are terrified of a human-made pandemic — and what we can do to stop it” VOX, Apr 5, 2022, <https://www.vox.com/22937531/virus-lab-safety-pandemic-prevention> GDI-TM]

DNA synthesis and how it changes the bioweapons calculus “Advances in synthetic biology and biotechnology make it easier than ever before to make pathogens more lethal and transmissible, and advances in the life sciences are occurring at a pace that governments have been unable to keep up with, which increases the risk of deliberate or accidental releases of dangerous pathogens,” Lieberman told the bipartisan Commission on Biodefense in March. One of the most exciting recent areas of progress in biology has been the increasing ease of DNA synthesis — the ability to “print” DNA (or RNA, which makes up the genetic material of viruses like influenzas, coronaviruses, measles, or polio) from a known sequence. It used to be that creating a specifically desired DNA sequence was incredibly expensive or impossible; now, it is much more straightforward and relatively cheap, with multiple companies in the business of providing mail-order genes. While scientific skill is still very much required to produce a virus, it is nowhere near as expensive as it used to be, and can be done by a much smaller team. Thomas Ybert, co-founder and CEO of biotech company DNA Script, works on the beta version of the world’s first benchtop DNA printer in August 2020, near Paris. In June 2021 DNA Script announced the commercial launch of the “printer,” which can create synthetic DNA fragments that can be used by laboratories. Eric Piermont/AFP via Getty Images This is great news; DNA synthesis enables a great deal of important and valuable biology research. But progress in DNA synthesis has been so fast that coordination against dangerous actors who might misuse it has lagged. Furthermore, checking the sequence against a list of known dangerous sequences requires researchers to maintain a list of known dangerous sequences — which is itself something bad actors could use to cause harm. The result is an “information hazard,” what the existential risk scholar Nick Bostrom defines as “risks that arise from the dissemination or the potential dissemination of true information that may cause harm or enable some agent to cause harm.” “DNA is an inherently dual-use technology,” James Diggans, who works on biosecurity at the industry-leading synthetic DNA provider Twist Bioscience, told me in 2020. What that means is DNA synthesis makes fundamental biology research and lifesaving drug development go faster, but it can also be used to do research that can be deadly for humanity.

### AT biodefense – increases risk of virus escape

#### Biodefense and bioweapons overlap – gain of function research proves and risk inadvertent spread

**Piper, 2022**

[Kelsay, “Why experts are terrified of a human-made pandemic — and what we can do to stop it” VOX, Apr 5, 2022, <https://www.vox.com/22937531/virus-lab-safety-pandemic-prevention> GDI-TM]

But the BWC is underfunded and little-prioritized despite the magnitude of the threat biological weapons pose. It has just a few staff members running its implementation support unit, compared to hundreds at the Chemical Weapons Convention, and a budget smaller than that of the average McDonald’s franchise. The US could easily bolster the BWC significantly with a relatively small funding commitment, and should absolutely do so. And despite the treaty’s broad aims, much of the work to identify dangerous pathogens that could potentially act as bioweapons is still ongoing — not as part of Cold War-era covert programs deliberately designed to create pathogens for military purposes, but through well-intentioned programs to study and learn about viruses that have the potential to cause the next pandemic. That means the Biological Weapons Convention does little to constrain much of the research that now poses the greatest risk of future biological weapons use, even if the release of those viruses would be entirely inadvertent.**One such type of science is what’s called “gain of function” research, in which researchers make viruses more transmissible or more deadly in humans as part of studying how those viruses might evolve in the wild**. “I first heard about gain of function research in the 1990s, only then we had a different term for it: biological weapons research and development,” Andy Weber, former assistant secretary of defense for nuclear, chemical, and biological defense programs in the Obama administration and now a senior fellow at the Council on Strategic Risks, told me. “The intent is 180 degrees off — NIH is trying to save the world from pandemics — but the content is almost entirely overlapping.” The status of gain of function research has been hotly contested over the last decade. In 2014, after the series of scary lab safety and containment failures I outlined above and after revelations of alarming gain of function work on bird flu, the NIH, which funds much of the cutting-edge biology research worldwide, imposed a moratorium on gain of function work on pathogens with pandemic potential like influenza or SARS. But in 2017, the moratorium was lifted without much explanation. Right now, the US is funding gain of function work at a few select laboratories, despite the objections of many leading biologists who argue that the limited benefits of this work aren’t worth the costs. In 2021, a bill was introduced to prohibit federal research grants that fund gain of function research on SARS, MERS, and influenza viruses.

#### Gain of function research increases risk of bioweapons research – ending funding for this research that on balance doesn’t help with pandemic

**Piper, 2022**

[Kelsay, “Why experts are terrified of a human-made pandemic — and what we can do to stop it” VOX, Apr 5, 2022, <https://www.vox.com/22937531/virus-lab-safety-pandemic-prevention> GDI-TM]

Beyond the risk that a virus strengthened through gain of function work might accidentally escape and trigger a larger outbreak — which is one theory, albeit unproven, for how Covid-19 began — it can be hard to differentiate legitimate, if risky, research from deliberate efforts to create malign pathogens. “Because of our government support for this risky gain of function research, we’ve created the perfect cover for countries that want to do biological weapons research,” Weber told me. The No. 1 thing he’d recommend to prevent the next pandemic? “Ending government funding for risky research that plausibly could have caused this and future pandemics.” Another potentially risky area of virology research involves identifying animal species that act as reservoirs of viruses that have the potential to cross over into humans and cause a pandemic. Scientists involved in this work go out to remote areas to take samples of those pathogens with dangerous potential, bring them back to the lab, and determine whether they might be able to infect human cells. This is precisely what researchers at the WIV apparently did in the years leading up to Covid-19 as they searched for the animal source of the original SARS virus. Such work was advertised as a way to prevent pandemic-capable pathogens from crossing over into humans, but it was largely useless when it came time to fight SARS-CoV-2, Weber says. “After having done this work for 15 years, I think there’s little to show for it,” Weber told me. That’s not the only view within the virology community, but it’s not a rare one. Weber thinks Covid-19 should lead to a rethinking. “As the intelligence community concluded, it’s plausible that it actually caused this pandemic. It was of zero help in preventing this pandemic or even predicting this pandemic.”

### AT no non-state actor access to DNA

#### Innovation caused by the plan could lower costs of tabletop synthesizers

**Piper, 2022**

[Kelsay, “Why experts are terrified of a human-made pandemic — and what we can do to stop it” VOX, Apr 5, 2022, <https://www.vox.com/22937531/virus-lab-safety-pandemic-prevention> GDI-TM]

That’s the conundrum that biosecurity researchers — in industry, in academia, and in the government — are faced with today: trying to figure out how to make DNA synthesis faster and cheaper for its many beneficial uses while ensuring every printed sequence is screened and hazards are appropriately handled. If that sounds like a challenging problem now, it’s only likely to get worse in the future. As DNA synthesis gets ever cheaper and easier, many researchers anticipate the creation of tabletop synthesizers that would allow labs to simply print their own DNA as needed for their research, no middleman needed. Something like a tabletop synthesizer could make for awesome progress in biology — and worsen the challenge of preventing bad actors from printing out dangerous viruses. And as DNA synthesis gets cheaper, screening for dangerous sequences becomes a larger percentage of the cost, and so the financial advantage of cutting corners on screening could become bigger, as companies that don’t do screening may be able to offer considerably lower prices.

## CRISPR bad – mutations in not targeted cells

#### CRISPR tech risk mutations – modifications risk cause mutations on non-targeted and targeted

**Leitch 22**

(Carmen Leitch, Research scientist, co-author of 30 peer-reviewed publications, B.S. in Biochemistry and Molecular Biology from University of Maryland, “CRISPR Causes Mutations That Are Passed on to Offspring,” LabRoots, February 2nd 2022, https://www.labroots.com/trending/genetics-and-genomics/22183/crispr-causes-mutations-passed-onto-offspring, accessed 7/9/2022, GDI- TMK)

There is little doubt that since it was created, the CRISPR-Cas9 gene editing system has been revolutionary in the research lab. Since there are some very small errors in the human genetic sequence that lead to serious and deadly diseases, researchers have long been searching for effective ways to repair those errors. But altering the genome is challenging, and comes with risks. In the CRISPR genome-editing technique, scientists can target a specific, short sequence of DNA with an enzyme called Cas9 that can cut genomic DNA. The tool is meant to selectively target the intended sequence, but the system is not error-proof. Some unintended cuts might occur, and the likelihood may depend on several factors, including what sequence is being taageted. There are also computational tools that are meant to help researchers select sequences that will not lead to off-target or unintended effects, or at least minimize that chance. There are also some experimental techniques that can reduce the risk. That specificity will be crucial if CRISPR-Cas9 is to be used widely in the clinic with patients. However, new research reported in Nature Communications has suggested that the CRISPR-Cas9 tool may be less exclusive than desired, and that unintended errors can be introduced which are then passed on to offspring. CRISPR may be very useful to modify the genomes of microbes, animals, or plants, but the study authors have suggested that the utmost caution should be used if CRISPR will be applied to patients. There are a few limited cases in which CRISPR has been used to treat people. In the United States, a small number of sickle-cell anemia patients who are adults have received the treatment (as explained in the video below). From what we know so far, it's been safe and effective. However, when a scientist in China claimed to have modified the genomes of human embryos who were later delivered, it was done under a veil of secrecy, and little is known about the outcome of those experiments. In this study, the researchers used a common research model, the zebrafish, to study the impact of CRISPR-Cas9 over two generations. Because zebrafish have many genes and biological processes in common with people, it's thought that they mimic what might be seen in other organisms including humans. The investigators assessed the genomes of over 1,000 zebrafish from two generations, and revealed unexpected mutations. There were also different kinds of mutations. In some cases, the fragments of DNA that were edited were much bigger than desired. In other instances, genomic mutations popped up in unintended places. These errors were seen in both the zebrafish that were treated with CRISPR and their offspring. "Knowing these unexpected mutations are heritable is important, since they can have long-term consequences for future generations. But that can happen only if you change the genome of embryos or germ cells," noted Ida Höijer, Ph.D. of Uppsala University. In the case of the sickle-cell patients, who are adults, their germ cells were not targeted and it would be assumed that there is little to no chance they'd be affected. That would also be the case for other tissues that might be targeted in adults with CRISPR. While these applications would theoretically pose no risk to future generations, the researchers noted that caution is still advisable.

## Designer babies

### 1nc/2ac – targeting people with disabilities

#### Biotech use governed by societal assumptions about ability, disease – used to unethically fix people

**McVicar 22**

(Tim McVicar, content writer and researcher and writes feature articles for The Lovepost, “Are designer babies ethical? CRISPR and how to avoid the slippery slopes of heritable genetic editing” The Lovepost, February 11th 2022, https://www.thelovepost.global/biotech-change/articles/are-designer-babies-ethical-crispr-and-how-avoid-slippery-slopes-heritable, accessed 7/10/2022, GDI- TMK)

Slippery slopes and putting the person back into our conceptions of disability and disease Several prominent academics argue that scientists, bioethicists and medical practitioners should not be the people solely informing ethical discussions about editing the human germline. They say that their ethical frameworks relative to medical safety, beneficence and informed consent are too limited to consider the possibilities of such editing appropriately. For example, Dr Sandy Sufian, Professor of Disability and Human Development at the University of Illinois, Chicago; and Dr John H. Evans, the Tata Chancellor’s Professor in Social Sciences and the co-director of the Institute of Public Ethics at the University of California, San Diego, could not have a more different view than Smith. Earlier this year, Sufian composed an op-ed with collaborator Dr Rosemarie Garland Thompson for Scientific American titled “The Dark Side of CRISPR,” arguing that the technology’s potential to “fix people” is a direct threat to the people society regards as “biologically inferior”. Their concern is also with the unreflective assumption that removing genetic disease through technology is actually beneficial for sufferers and society. “This is a technology that will be used with people, affecting people, affecting the social world, in terms of who inhabits the world,” Sufian says. “When you are conceptually detaching a technology from the person, then you can claim that it is not against people with disabilities per se, and you can make the argument that it is a universal good.” Sufian believes that most people think germline editing technology is inherently beneficial and that this applies even to the people with the genetic condition that could be targeted for elimination. This is because of the common perception that disease is bad and should be avoided or eradicated. Yet Sufian and Garland think that people cannot be reduced to their disease exclusively—it is a small portion of their human experience—and instead of eliminating the disease, the priority should be maximising the human potential of the affected person. Evans, for his part, has applied a sociological ‘slippery slope’ metaphor to describe the ethical implications of germline editing. He argues that CRISPR technologies, coupled with a reductionist medical ethical value system, have breached the ethical limit between genetically targeting somatic disease and editing for enhancement, a line that societies have traditionally used to prevent unethical experimentation on humans. His 2020 book, The Human Gene Editing Debate, describes this nondeterministic slippery slope as having step A at the top, the most meritorious action, such as physician-assisted euthanasia or somatic genetic editing for severe disease, which is the least controversial, to step D at the bottom of the slope, the most maximally objectionable action, such as involuntary euthanasia or non-therapeutic genetic modification for enhancement in capabilities and traits such as intelligence. Evans argues the descent down the slope is encouraged by the social normalisation of interventions, which increases the odds of accepting and legitimising more ethically controversial interventions further down the line. This process occurs in many domains and is arguably a key feature of how cultures change; a normative process rather than an aberration. Evans offers the following description of how descent down the slope could occur with genetic editing: Everyone agrees that targeted gene editing for somatic sickle cell disease is morally virtuous. So, let’s get on the slope and do that. There are people suffering. The problem is that you have now changed the conditions for step B: I’m used to the idea of genetically modifying humans now, so I guess [I can consider step] B where I’m not modifying sickle cell but something like genetically caused deafness. Well, it’s kind of a disease, but it’s also kind of not a disease, but I’m kind of used to this, so I’ll go there—so that becomes normalised... At the bottom is the Brave New World or Gattaca situation, which is a society where people are designed for particular genes for particular purposes.

### Extensions – gene editing long term consequences

#### Gene editing poses long term consequences – mutations that get fixed impact overall viability of the embryo

**Marchione 20**

(Marilynn Marchione, former Chief Medical Writer for AP news, coverage coordinator of the New England Journal of Medicine, “Lab tests show risks of using CRISPR gene editing on embryos” AP News, October 29, 2020, https://apnews.com/article/science-67e4ab5bd26dd68504bb255b1e64d418, accessed 7/10/2022, GDI- TMK)

A lab experiment aimed at fixing defective DNA in human embryos shows what can go wrong with this type of gene editing and why leading scientists say it’s too unsafe to try. In more than half of the cases, the editing caused unintended changes, such as loss of an entire chromosome or big chunks of it. Columbia University researchers describe their work Thursday in the journal Cell. They used CRISPR-cas9, the same chemical tool that a Chinese scientist used on embryos in 2018 to help make the world’s first gene-edited babies, which landed him in prison and drew international scorn. The tool lets scientists cut DNA in a precise spot and has profound potential for good — it’s already used to raise better crops and livestock, holds promise for treating diseases and earned its discoverers a Nobel Prize earlier this month. But using it on embryos, sperm or eggs makes changes that can pass to future generations. Several international panels of scientists and ethicists have said it’s too soon to know whether that can be done safely, and the new Columbia work shows the possible harm. “If our results had been known two years ago, I doubt that anyone would have gone ahead” and tried it on embryos intended for pregnancy, said biologist Dieter Egli, who led the study. Researchers made 40 embryos with eggs from healthy donors and sperm from a man with a gene mutation -- a single letter missing in the DNA alphabet -- that causes blindness. Editing was aimed at adding the missing letter so the gene would work. In some embryos, the editing was tried at fertilization, thought to be the best time for such attempts. Other embryos were edited when they contained two cells and were almost two days old. Cells then were analyzed at various stages of development to see how many had the mutation repaired. Surprisingly, it didn’t work in any of the cells from embryos edited at fertilization. It only worked in three of the 45 cells from embryos edited at the later stage. In many of the rest, “what we found is that instead of the mutation being fixed, the chromosome carrying the mutation is gone” — a profound change that likely dooms the embryo, Egli said. Many other cells showed changes in other chromosomes that also could do harm. Previous researchers who thought they had repaired a defect in embryos may have been misled into thinking they had succeeded because usual lab tests no longer detected the mutation. However, more extensive testing like what was done in this study shows that other changes could have happened, such as an entire chromosome being wiped out, Egli said. The new work suggests that gene editing might hold promise for correcting disorders caused by an extra copy of a chromosome, such as Down syndrome. However, the danger revealed in the new study “further affirms we are not ready, not even close” to try this, Dr. Eric Topol wrote in an email. “This takes the concerns that have already been expressed about human embryo editing to another level,” added Topol, who heads the Scripps Research Translational Institute in San Diego and had no role in the new work. In the U.S., federal funds can’t be used for research on human embryos, so the Columbia researchers used private money from two foundations. Several of the scientists have ties to gene therapy or analysis companies.

## Gene drive bad – species extinction

### 1nc – gene drive

#### Gene drive risk irreversible effects on ecosystems

**Economist 2019**

[“[The promise and peril of gene drives” the Economist Updated May 21 2019 https://www.economist.com/briefing/2018/11/08/the-promise-and-peril-of-gene-drives](file:///C:\Users\debate\Dropbox\0-NATO\1-%20GDI\Area%20impact%20turn%20debate\The%20promise%20and%20peril%20of%20gene%20drives) GDI TM]

Needless to say, the enthusiasm is not universal. Other environmental groups worry that it will not prove possible to contain gene drives to a single place, and that species seen as invasive in one place might end up decimated in other places where they are blameless, or even beneficial. If drives are engineered into species that play a pivotal but previously unappreciated ecological role, or if they spread from a species of little ecological consequence to a close relative that matters more, they could have damaging and perhaps irreversible effects on ecosystems.

Such critics fear that the laudable aim of vastly reducing deaths from malaria—which the World Health Organisation puts at 445,000 a year, most of them children—will open the door to the use of gene drives for far less clear-cut benefits in ways that will entrench some interests, such as those of industrial farmers, at the expense of others. They also point to possible military applications: gene drives could in principle make creatures that used not to spread disease more dangerous.

### Extensions – gene drive

#### Gene drives risk extinction of species – placement of gene drive key

**Economist 2019**

[“[The promise and peril of gene drives” the Economist Updated May 21 2019 https://www.economist.com/briefing/2018/11/08/the-promise-and-peril-of-gene-drives](file:///C:\Users\debate\Dropbox\0-NATO\1-%20GDI\Area%20impact%20turn%20debate\The%20promise%20and%20peril%20of%20gene%20drives) GDI TM]

Although allegations of playing God are two a penny in debates about breakthrough technologies, with gene drives they do feel better-founded than usual. The ability to remove species by fiat—in effect, to get them to remove themselves—is, like the prospect of making new species from scratch, a power that goes beyond the past ambit of humankind. Gene drives are, at heart, a particularly selfish sort of gene. Most animals have two copies of most of their genes, one on the set of chromosomes they got from their mother, one on those from their father. But they put only one version of each gene—either the maternal one or the paternal one, at random—into each of their own gametes (sperm or eggs). Some genes, though, seek to subvert this randomising in order to get into more than 50% of the gametes, and thus more than 50% of the next generation. In 1960 George Craig, an American entomologist, suggested that such subversive genes might be a way of controlling the populations of disease-carrying mosquitoes, for example by making them more likely to have male offspring than female ones. In 2003 Austin Burt, at Imperial College, described how a gene drive that could cut a place for itself in a chromosome and copy itself into the resulting gap could, in the right circumstances, drive a species to extinction. A fascinating idea, but one hard to put into practice—until, in 2012, a powerful new gene-editing tool called crispr-Cas9 became available. Gene drives based on crispr-Cas9 could easily be engineered to target specific bits of the chromosome and insert themselves seamlessly into the gap, thus ensuring that every gamete gets a copy (see diagram). By 2016, gene drives had been created in yeast, fruitflies and two species of mosquito. In work published in the journal Nature Biotechnology in September, Andrea Crisanti, Mr Burt and colleagues at Imperial showed that one of their gene drives could drive a small, caged population of the mosquito Anopheles gambiae to extinction—the first time a gene drive had shown itself capable of doing this. The next step is to try this in a larger caged population.

#### Gene drive spillover to related plants species

**Economist 2019**

[“[The promise and peril of gene drives” the Economist Updated May 21 2019 https://www.economist.com/briefing/2018/11/08/the-promise-and-peril-of-gene-drives](file:///C:\Users\debate\Dropbox\0-NATO\1-%20GDI\Area%20impact%20turn%20debate\The%20promise%20and%20peril%20of%20gene%20drives) GDI TM]

In a report published in 2016, America’s National Academies of Science highlighted the possibility of drives introduced for agricultural reasons damaging people’s welfare. Excoriated as “pigweed” in the United States, related species of the plant are cultivated for food in Mexico, South America, India and China. American farmers might like a gene drive to eradicate pigweed, which has become resistant to the herbicide glyphosate, which is widely used in conjunction with today’s genetically modified crops. But they would not necessarily bear the risks, or liability, of a release that went on to do damage to food crops in other countries.

## Military applications

### Extensions - China expanding research – military applications

#### China increasing investment and experimentation into use of CRISPR

**Rabiah, 2021**

[Yusef Paolo, PhD Candidate at Science, Technology, Engineering and Public Policy, UCL“From bioweapons to super soldiers: how the UK is joining the genomic technology arms race” The Conversation April 29 2021 <https://theconversation.com/from-bioweapons-to-super-soldiers-how-the-uk-is-joining-the-genomic-technology-arms-race-159889> GDI-TM]

Universal Soldier and Captain America are just a few Hollywood movies that have explored the concept of the super soldier. Despite its sci-fi nature, several countries are looking to explore the potential of such prospects. Darpa intends to explore genetically editing soldiers to turn them into “antibody factories”, making them resistant to chemical or biological attacks.

In December 2020, the then US director of national intelligence, John Ratcliffe, said there was evidence that the Chinese military was conducting human experimentation in an attempt to biologically boost soldiers. This followed a report by the Jamestown policy thinktank that highlighted reports suggesting that Crispr would form a keystone technology in China to “boost troops’ combat effectiveness”. No further details were given, however.

#### China increased research into military applications of CRISPR

**Dilanian, 2020**

[Ken, “China has done human testing to create biologically enhanced super soldiers, says top U.S. official” NBCNews December 3, 2020 <https://www.nbcnews.com/politics/national-security/china-has-done-human-testing-create-biologically-enhanced-super-soldiers-n1249914> GDI-TM]

Last year, two American scholars wrote a paper examining China's ambitions to apply biotechnology to the battlefield, including what they said were signs that China was interested in using gene-editing technology to enhance human — and perhaps soldier — performance. Specifically, the scholars explored Chinese research using the gene-editing tool CRISPR, short for "clusters of regularly interspaced short palindromic repeats." CRISPR has been used to treat genetic diseases and modify plants, but Western scientists consider it unethical to seek to manipulate genes to boost the performance of healthy people. "While the potential leveraging of CRISPR to increase human capabilities on the future battlefield remains only a hypothetical possibility at the present, there are indications that Chinese military researchers are starting to explore its potential," wrote the scholars, Elsa Kania, an expert on Chinese defense technology at the Center for a New American Security, and Wilson VornDick, a consultant on China matters and former Navy officer. "Chinese military scientists and strategists have consistently emphasized that biotechnology could become a 'new strategic commanding heights of the future Revolution in Military Affairs,'" the scholars wrote, quoting a 2015 article in a military newspaper.

### Extension – military applications

#### Multiple countries pursuing military application of CRISPR

**Rabiah, 2021**

[Yusef Paolo, PhD Candidate at Science, Technology, Engineering and Public Policy, UCL“From bioweapons to super soldiers: how the UK is joining the genomic technology arms race” The Conversation April 29 2021 <https://theconversation.com/from-bioweapons-to-super-soldiers-how-the-uk-is-joining-the-genomic-technology-arms-race-159889> GDI-TM]

The UK government recently announced an £800 million, taxpayer-funded Advanced Research and Invention Agency (Aria). The brainchild of the British prime minister’s former chief adviser, Dominic Cummings and modelled on the US Defense Advanced Research Projects Agency, Darpa, the organisation will focus partly on genomic research. Genome technology is becoming an increasingly important part of military research. So given that the UK boasts some of the best genomic research centres in the world, how will its new agency affect the wider genome technology warfare race? In 2019, Darpa announced that it wishes to explore genetically editing soldiers. It has also invested over US$65 million (£45 million) to improve the safety and accuracy of genome-editing technologies. These include the famous Nobel prize-winning Crispr-Cas molecular scissor – a tool that can edit DNA by cutting and pasting sections of it. But the ease of accessibility and low cost of Crispr-based technologies has caused concern around potential military genetic modification and weaponisation of viruses or bacteria. These include smallpox or tuberculosis, and could be extremely destructive. The US is not alone in its military pursuit of genome technology. Russia and China have either stated or been accused of using genomic technology to enhance military capabilities.

### AT tech doesn’t exist to make super soldiers

#### Tech exists – only thin barrier of whether scientist will choose to use

**Poole, 2021**

[Thom, “The myth and reality of the super soldier” BBC8 February 2021 <https://www.bbc.com/news/world-55905354> GDI-TM]

Dr Helen O'Neill, a molecular geneticist from University College London, said the question was more about whether scientists would be prepared to use this technology, rather than whether it was possible. "The technologies - of genome editing and its combination with assisted reproduction - are becoming routine practices in transgenics and agriculture, it's just the combination of the two for human use that is seen as unethical at the moment."2