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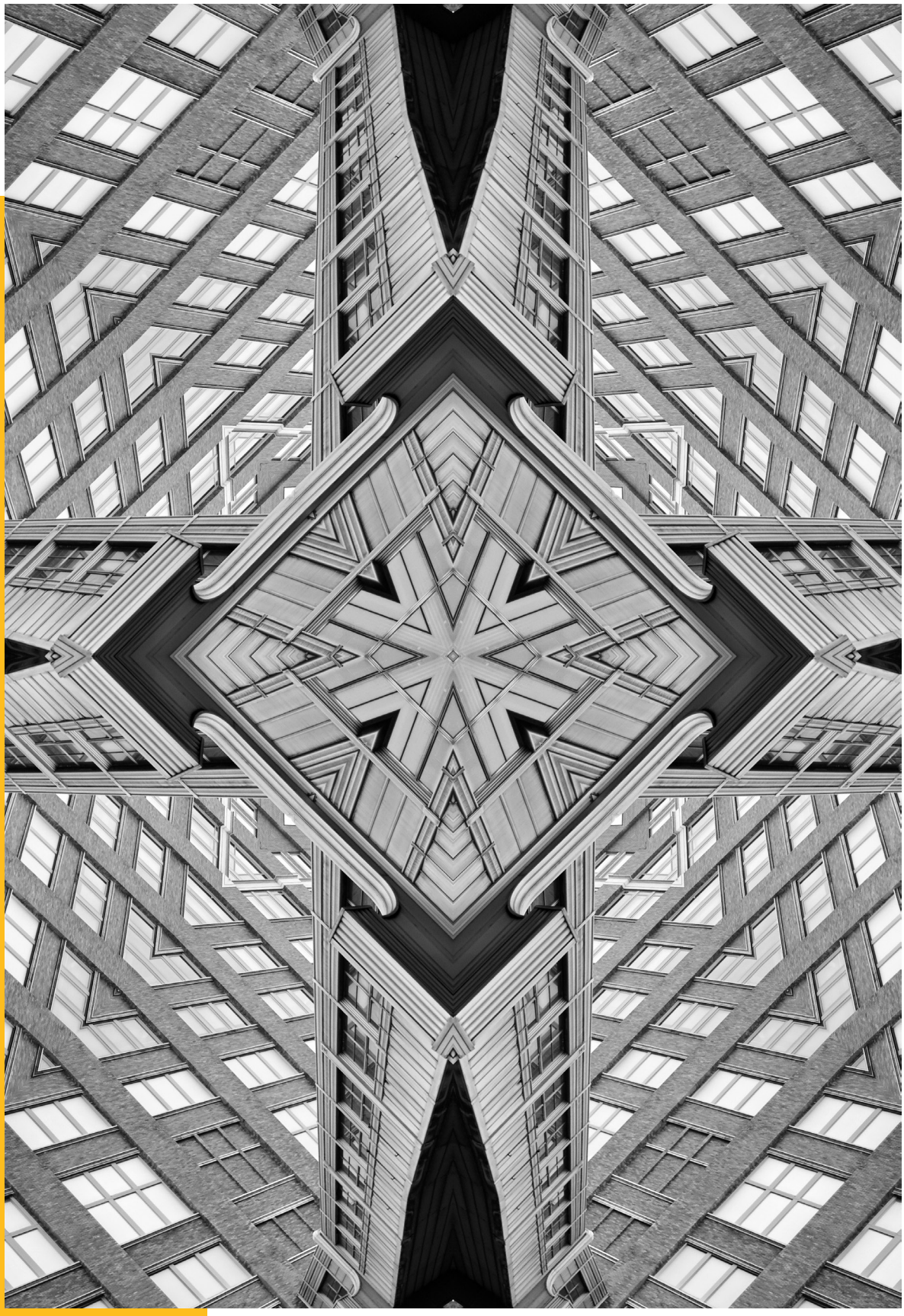

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Strengthening CBRN Security in India: Domestic Strategies and Global Collaborations

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Abstract

India's geopolitically sensitive location and complex relationships with neighbours, global powers, and non-state actors necessitate national security strategies that include the Chemical, Biological, Radiological, and Nuclear (CBRN) domain. This paper discusses the current threat scenario related to CBRN technologies; it makes a case for leveraging multilateral cooperation through alliances like the Quad and regional partnerships to strengthen intelligence sharing, research collaboration, and coordinated response strategies. It outlines policy recommendations to be included in an overarching CBRN Security Strategy beyond the existing framework.

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Introduction

India has yet to frame a national security strategy or a national security doctrine, instead relying on existing military strategies and directives, such as the Raksha Mantri's Operational Directive of 2009 and the more recent Joint Doctrine of the Indian Armed Services 2017, which is currently referred to in operational strategic activities.[1,2] In November 2023, the National Security Council Secretariat (NSCS) initiated the formulation of a National Security Strategy (NSS),[3] highlighting the urgent need for a comprehensive framework to protect India's core national interests and provide a clear vision of priorities, growth directions, deterrence strategies, and scope for international alliances.

Creating an NSS is a complex task. It requires a comprehensive analysis of the geospatial, geodemographic, and geopolitical landscape and an examination of possible future scenarios. The NSS must include factors such as strategic deterrence, counterterrorism, economic security, cybersecurity, climate change, and food security. A strategy such as this one must also be accompanied by a chemical, biological, radiological, and nuclear (CBRN) strategy that oversees threat detection, non-proliferation, and deterrence.[a]

Chemical threats involve the use of toxic chemical substances to inflict harm. Chemical weapons can be dispersed in various forms, such as gases, liquids, or solids, and can cause immediate or delayed effects, ranging from temporary incapacitation to death.[4] Examples include nerve agents like sarin[b] and VX[c] and choking agents like chlorine gas. Chemical weapons are difficult to access through formal means because they are heavily monitored under the Chemical Weapons Convention Act (CWC Act); however, Toxic Industrial Chemicals (TICs), which include common acids and pesticides, are relatively easily accessible and affordable and can be used by threat actors.[5,6]

Biological threats encompass the use of pathogens or toxins to cause disease and death in humans, animals, or plants. These agents can be bacteria, viruses, or toxins from living organisms. Biological weapons can have profound impacts due to their potential to spread uncontrollably, as

a CBRN deterrence aims to discourage potential adversaries from considering these weapons by maintaining robust defensive capabilities, credible retaliatory threats, and diplomatic initiatives.

b Sarin is a synthetic chemical warfare nerve agent and is one of the most toxic and rapidly acting known nerve agents.

c More toxic than sarin, VX is a synthetic chemical compound developed for military use in chemical warfare.

seen with diseases like anthrax or smallpox. More recent cases of biological agent use include the 2001 anthrax attacks on senators in the United States (US).[7] While biological agents as weapons are rarely used in modern warfare, their potential of use and the subsequent impact on humans, food security, and the environment highlight the need for continued security.[8]

Radiological threats, meanwhile, involve the use of radioactive materials to cause harm through contamination or radiation exposure. The most common form of radiological threat is a "dirty bomb", which disperses radioactive material using conventional explosives. While less catastrophic than nuclear weapons, radiological weapons can cause significant panic, long-term health issues, and environmental contamination.[9] Nuclear threats are the most severe and commonly discussed of the CBRN threats, involving the use of nuclear weapons to cause massive destruction and loss of life. The detonation of a nuclear weapon results in immediate, large-scale devastation due to the explosion, intense heat, and subsequent radiation.[10]

CBRN threats emerged as critical factors in global security in the early 20th century. The use of chemical weapons during the First World War marked the beginning of large-scale CBRN warfare, with chlorine gas and mustard gas being deployed in the trenches, with devastating effects on soldiers and civilians.[11] This led to initial international efforts to ban the use of chemical and biological weapons, culminating in the Geneva Protocol of 1925.[12] The Second World War saw the initiation of the nuclear age, with the Manhattan Project and the subsequent bombings of Hiroshima and Nagasaki in 1945.[13,14] The sheer destructive power of nuclear weapons shifted the paradigm of warfare and introduced the concept of nuclear deterrence,[d] which became a cornerstone of Cold War geopolitics.

d The theory of deterrence posits that the threat of nuclear retaliation would prevent adversaries from initiating a nuclear conflict.

Past CBRN Incidents and Potential Threats in India

India's perception of CBRN threats is shaped by its geopolitical positioning, relationships with its neighbours, risks from terrorism, and the potential for natural or accidental CBRN incidents. Indeed, South Asia has been a focal point for CBRN threats due to the region's complex geopolitical dynamics and historical conflicts.[15]

From 2014 to 2017, the Islamic State (IS) orchestrated between 41 and 76 alleged chemical attacks, predominantly involving chlorine and sulphur mustard, across Iraq and Syria.[16] This marked an unprecedented scale of chemical weapon deployment by a non-state actor and was likely the first instance where an Islamic terrorist group successfully assembled and launched chemical payloads via projectiles. These actions, occurring at the height of the IS's operations, showcased a disturbing evolution in terrorist capabilities and tactics. Between 2014 and 2020, there were only three incidents of large-scale chemical weapons use in Southeast Asia—in Indonesia and the Philippines—none of which have been attributed to any terror group.[17] In 2019 in West Bengal, India, a group of individuals threw exploding devices rigged with chemicals and acids at Trinamool Congress[e] party members, resulting in injuries to eight individuals. No terrorist or non-state organisation has taken accountability for the event. In similar instances, individuals have used easily accessible toxins such as acids and pepper spray in combination with other weapons.[f] However, attacks using dirty bomb in combination with CBRN materials has been seen across South Asia, highlighting India's need to avoid complacency.[18]

Post the Pulwama incident in 2019, India has experienced few instances of terrorism at a large scale. However, this does not mean that future terrorist threats have diminished. In 2017, Indonesian authorities, also then undergoing a period of relative political stability, foiled a plan by a pro-IS Jamaat Ansharud Daulah (JAD) cell to construct a radiological dispersal device with Uranium-233.[19] The case of the IS cell in Indonesia highlights

e A state party in India.

f In 2014, three women were wounded when assailants threw acid at them in Siliguri district, West Bengal, with no group claiming responsibility for that attack. In 2015, assailants stormed the residence of Bharatiya Janata Party leader Muralidhar Kawra in Ujjain, Madhya Pradesh, throwing acid on him and his family; again, no group claimed responsibility. In 2016, assailants threw acid in the face of Aam Aadmi Party leader Soni Sori on a road between Bastanar and Geedam in Chhattisgarh, with no group claiming responsibility. In 2018, a bank guard named Mumtaz Ahmad was attacked at the Jammu and Kashmir Bank branch in Khrew, with no group claiming responsibility for the incident.

that India must prioritise a comprehensive strategy to adapt to a changing geopolitical climate and to tackle the possibility of future threats.

Regional Scenario

Pakistan

Pakistan represents a significant CBRN threat to India due to the former's nuclear capabilities and the historical tensions between the two nations.[20] Tensions over the Kashmir region have especially led to several military confrontations, raising concerns about the potential for escalation to nuclear conflict. Pakistan's nuclear arsenal is estimated to be substantial (currently estimated at 170 compared to India's 164) and continues to grow, with the country reportedly developing tactical nuclear weapons that could be deployed on the battlefield.[21]

Beyond nuclear weapons, there are concerns about Pakistan's chemical and biological capabilities. At the October 2022 United Nations General Assembly (UNGA) First Committee meeting to discuss the possibility of averting future pandemics, Khalil Hashmi, then Ambassador of Pakistan to the UN, voiced concerns about the potential of non-state actors and states accessing biological and chemical agents.[g],[22] While the country is undersigned to the Biological Weapons Convention (BWC) and the Chemical Weapons Convention (CWC), the relationship of the country with non-state actors, such as Lashkar-e-Taiba (LeT) and Jaish-e-Mohammed (JeM), and the potential for covert development or use of such weapons cannot be entirely ruled out, especially given the presence of various militant groups within its borders.[23]

Bangladesh

In the October 2022 UNGA meeting, Bangladesh's representative Khandker Anwarul Islam expressed concerns about non-state actors' access to weapons of mass destruction, highlighting the impact of the pandemic in the country and how it may mirror any intentionally disastrous outcomes.[24] Due to the

g Chemical agents include TICs and weaponisable chemicals.

proximity of Bangladesh to India and the complex relationship between both countries, a non-state actor's access to such weapons may threaten the regions near India's border, and a non-mitigated disaster can spread quickly.[25]

China

China's nuclear doctrine emphasises a "No First Use" policy[h] similar to India's. However, China's growing nuclear arsenal and modernisation efforts, including developing new missile systems and submarines, indicate that India needs to remain vigilant.[26,27]

In addition to its nuclear capabilities, China has made advancements in biotechnology and Artificial Intelligence (AI), leading to concerns about the potential development of biological weapons.[28] China's vast industrial base and scientific expertise make it a potential source of chemical and biological materials that could be weaponised by the state or through unauthorised access by non-state actors.

Terrorism and Insurgency

The threat of CBRN terrorism is a growing concern for India, particularly given the presence of various insurgent and terrorist groups that may seek to acquire or use CBRN materials. Groups like LeT, JeM, and the Indian Mujahideen (IM) have a history of conducting high-profile attacks.[29] While they have so far used only conventional weapons,[i] the potential intent and capability to pursue CBRN weapons, along with their history of violent and large-scale attacks, heighten concerns. CBRN weapons, with their ability to cause mass devastation and panic, present an attractive option for such organisations, which aim to cause large-scale harm. Using radiological or chemical materials could allow them to escalate their attacks by exploiting vulnerabilities in the system. The 1995 sarin gas attack in Tokyo, attributed to the Aum Shinrikyo cult, indicates the ease with which non-state actors can

h The 'No First Use' policy communicates to other countries China's resistance in using nuclear weapons as a first resort in war zones.

i The potential for mass impact and fear is evident in the 2008 Mumbai attacks, where LeT terrorists used firearms and explosives to target multiple locations, resulting in over 170 deaths (See: https://www.state.gov/reports/country-reports-on-terrorism-2019/#LeT). This attack used conventional weapons and had a marked impact on Indian security. The capability of these groups to access and deploy CBRN technologies and weapons, or even allude to their use, can create larger disasters or a greater sense of fear and distrust amongst Indian citizens.

Past CBRN Incidents and Potential Threats in India

weaponise chemical agents to inflict casualties and create panic. If groups like LeT or JeM are able to access similar materials, the consequences could be catastrophic.[30]

Insurgent groups in regions like Jammu and Kashmir and the Northeast further complicate matters. These groups, often guided by ideology or ideological leaders, can be easily motivated to use CBRN materials to further their agendas. Insurgencies in the Northeast, which are often driven by ethnic and regional grievances, may seek unconventional means to challenge state authority. Thus far, none of these insurgent groups have resorted to using CBRN materials. However, even an attempt to target industrial or infrastructure sites that host such materials could result in an unintended attack. For example, Maoists have targeted industrial facilities and railway lines, disrupting state infrastructure.[31] The Maoist insurgency, while primarily focused on conventional guerrilla warfare, has been identified as a potential threat, particularly if it gains access to industrial chemicals or radiological materials.[32] If they are able to obtain hazardous chemicals or radiological sources from these industrial hubs, the potential for a CBRN attack would increase. While their primary focus remains guerrilla warfare, the sheer accessibility of certain industrial materials in the regions they control increases the overall risk of a CBRN incident.

The vast size and complexity of India's industrial and healthcare infrastructure create opportunities for potential CBRN exploitation. Chemical weapons, in particular, present an immediate risk due to their wide availability for industrial processes. TICs such as chlorine or pesticides, which are commonly used in agriculture and manufacturing, can be easily weaponised. A well-coordinated attack, either physical or cyber, on a chemical storage facility could release harmful substances, resulting in mass casualties and widespread panic in densely populated urban areas. [j,33]

A similar attack on a biosafety lab or a factory can lead to a large-scale health crisis.[34] However, the use of biological weapons such as anthrax is rare. Biological weapons have not seen large-scale use since 2001 in the

j An example of this can be seen in Saudi Arabia, which has a large chemical industry and has seen many leaks and accidents. The number of accidents peaks in 2010-2019, totalling approximately 30 in that decade. Saudi Arabia has also seen multiple cyberattacks on its chemical plants. While these vulnerabilities have not resulted in a coordinated attack yet, the consistency of these vulnerabilities is a gap waiting to be exploited. See: https://www.dni.gov/files/ODNI/documents/assessments/Declassified-Assessment-on-COVID-19-Origins.pdf

United States.[k] While not considered to be an attack, the COVID-19 virus has been attributed to a potential biosafety lab leakage.[35] The outcomes highlighted that even an attack on a lab may result in the leak of a highly viral pathogen and have a global impact.

Radiological materials are more accessible than nuclear weapons and could be used in a radiological dispersal device, commonly referred to as a "dirty bomb". Such a device, which combines conventional explosives with radioactive material, would not necessarily cause high death tolls but could spread contamination over a wide area, causing significant disruption and long-term health concerns. Additionally, the nuclear threat, although the least likely, cannot be dismissed. India is a nuclear power, and while it has stringent security around its nuclear materials, the possibility of insider collusion or rogue elements seeking to acquire fissile material poses a real risk.[36]

Industrial Accidents, Negligence, and Potential Attacks

India's rapid industrialisation poses significant CBRN risks. The country has several chemical plants, nuclear facilities, and other industries that handle hazardous materials, which poses a persistent risk of accidental release of toxic chemicals or radioactive substances, as in the Bhopal Gas Tragedy of 1984.[l] More recently, in 2020, a similar incident arising from negligence was seen during the Visakhapatnam gas leak.[m,37] The Mayapuri incident of 2010[n] further highlights the need for stringent regulations and public awareness to prevent accidental CBRN incidents.

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k In 2001, letters laced with anthrax were sent to political leaders and stakeholders, resulting in five deaths and 17 infected and injured individuals.

l Although not a deliberate CBRN attack, the Bhopal disaster remains one of the deadliest chemical accidents in history. The release of methyl isocyanate gas from a Union Carbide pesticide plant led to thousands of deaths and long-term health issues. The incident highlighted the need for stringent safety protocols and emergency preparedness to handle hazardous chemicals. See: https://doi.org/10.1186/1476-069x-4-6

m The Vishakhapatnam gas leak happened in 2020, when styrene gas leaked from the LG Polymers chemical plant, resulting in over 1,000 affected individuals in the first count of hospitalisations and several others reporting sickness and fatalities.

n The incident took place in Mayapuri in Delhi, where a scrap dealer was exposed to radioactive Cobalt-60. While nothing came of the situation, such materials landing in the possession of malicious actors can have catastrophic results.

Past CBRN Incidents and Potential Threats in India

Industrial accidents can lead to large-scale CBRN incidents with devastating effects on public health and the environment. Factors such as inadequate safety protocols, ageing infrastructure, and human error exacerbate the potential for accidents. Ensuring stringent safety standards, regular inspections, and emergency preparedness plans is essential to mitigate these risks. Thus, any CBRN-focused NSS must consider physical attacks and cyberattacks on industrial plants that result in the loss of integrity of materials, theft, or even staff privacy.

Natural Disasters

India is prone to many natural disasters, including earthquakes, floods, and cyclones, which can exacerbate CBRN risks. The Fukushima nuclear disaster in Japan following the 2011 earthquake and tsunami highlights how natural disasters can trigger CBRN emergencies.[38] At present, the CBRN defence ecosystem in India is mainly covered under the National Disaster Management Authority (NDMA).[39] A comprehensive NSS must also consider how the chaos following a natural disaster can be used to exploit and exacerbate CBRN risks. India's disaster management frameworks need to ensure that industrial and nuclear facilities are designed to withstand natural disasters and that emergency response plans are in place.

Other concerns include the accidental release of hazardous materials during transportation, improper disposal of industrial waste, and incidents involving medical or research facilities that handle radioactive or biological materials. In 2023, India had a limited outbreak of anthrax in Koraput District, Orissa,[40] which was attributed to the consumption of tainted meat in a local village, resulting in the rapid spread of anthrax. The COVID-19 pandemic also tested India's public health infrastructure, emergency response systems, and social resilience, prompting calls for strengthening India's biosecurity framework, improving disease surveillance, revamping biosafety monitoring governance and reporting mechanisms, and enhancing international cooperation in the face of global health threats.[41]

The Role of CBRN Strategy in India's National Security

Intentional, accidental, or natural CBRN deterrence is a cornerstone of India's national security strategy. CBRN deterrence includes a range of measures designed to prevent the development, proliferation, and use of CBRN weapons. These measures are discussed below.

Diplomatic Engagements

Diplomatic efforts involve international diplomacy to strengthen non-proliferation treaties and form alliances and partnerships to enhance collective security against CBRN threats. The United Nations Security Council passed resolution 1540 in 2004 to prevent the proliferation of CBRN weapons of mass destruction, highlighting the need for individual countries' plans of action and mitigation. This resolution has subsequently been extended several times, most recently in UNSCR 2663.[42] The United Nations Office on Drugs and Crime also has a CBRN Terrorism Prevention Programme.

International bodies have deployed policing tools and guidelines to help mitigate CBRN threats, such as the INTERPOL's CBRNe (Chemical, Biological, Radiological, Nuclear explosives) programme, bioterrorism preparedness programme, and other interactions with the UN and individual countries through conferences, training modules, and guidebooks to unite global and border policing.[43,44] At the international level, the trade of dangerous goods is also monitored by the World Customs Organization's (WCO) Container Control Programme (CCP) and Strategic Trade Control Enforcement (STCE) programme for the control of strategic goods and dual-use items. These treaties and programmes view CBRN as a threat area of terrorism. India is also a signatory to many global treaties that have different approaches to CBRN threats. Rather than view them as terror risks alone, these treaties govern outcomes, therefore governing risks in all forms, including attacks, negligence, and natural disasters.

Table 1: International Treaties in CBRN Threats and Response

Treaty	India's Status	Details
Treaties on Nuclear and Radiological Materials		
Nuclear Non-Proliferation Treaty (NPT)	India is not a signatory.	The NPT is a multilateral agreement between countries globally to discourage the use and proliferation of nuclear weapons. India is one of the few countries that has not signed the NPT, arguing that the treaty is discriminatory as it recognises only the five permanent members of the UN Security Council as nuclear-weapon states.[45] However, India has expressed its commitment to non-proliferation and has maintained a responsible nuclear posture, including a voluntary moratorium on nuclear testing.[46,47]
Convention on the Physical Protection of Nuclear Material (CPPNM)	India is an active member.	The CPPNM is an international treaty that ensures the protection of nuclear facilities for development of energy, domestic use during storage or transfer. India has a long-standing relationship with the International Atomic Energy Agency (IAEA), cooperating on nuclear safety, security, and safeguards. It also actively participates in IAEA initiatives aimed at preventing nuclear terrorism and enhancing global nuclear security.[48] India does adhere to international protocols, including the CPPNM, reinforcing its commitment to preventing nuclear terrorism.[49]

Treaty	India's Status	Details
International Convention for Suppression of Acts of Nuclear Terrorism (2005)	India is not a signatory.	The convention is an international tool to prevent and combat nuclear terrorism by establishing a legal framework for prosecuting threats to use nuclear devices with the intent to cause harm. The UNGA introduced the convention in response to the 9/11 attacks in the US. India is undersigned to the convention, reaffirming its commitment to deterring nuclear terrorism. [50]
Comprehensive Nuclear-Test-Ban Treaty (CTBT)	India is not a signatory.	The CTBT is an international treaty that prohibits all nuclear explosions for both civilian and military purposes. Similar to the NPT, India has not signed the CTBT but has maintained a voluntary moratorium on nuclear testing since its last tests in 1998.[51] India's stance on the CTBT is linked to its broader concerns about nuclear disarmament and the need for a global, non-discriminatory approach to nuclear arms control.
Treaties on Biological Agents		
Biological Weapons Convention (BWC)	India is a signatory.	The BWC prohibits the development, production, and stockpiling of biological weapons. India has consistently supported strengthening the BWC to include verification measures, and it participates in international efforts to prevent the misuse of biological research.[52]

Treaty	India's Status	Details
Convention on Biological Diversity (CBD)	India is a signatory.	The CBD has two main segments. The Cartagena Protocol on Biosafety (2000) establishes procedures for the safe transfer, handling, and use of Living Modified Organisms (LMOs), focusing on transboundary movements.[53] The Nagoya Protocol (2010) provides a legal framework for access to genetic resources and sharing benefits arising from their use. It ensures that users of genetic resources respect the rights of the countries providing them and indigenous communities.[54]
Treaties on Chemical Agents		
Chemical Weapons Convention (CWC)	India is a signatory.	The CWC prohibits the production and use of chemical weapons. India has destroyed its chemical weapons stockpile in compliance with the convention and supports global initiatives to prevent the re-emergence of chemical weapons. India has also established a National Authority Chemical Weapons Convention inspired by the convention.[55]
Basel Convention	India is a signatory.	The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal imposes a ban on the improper handling on hazardous materials, improper disposal, and non-monitored waste management of leaks.[56]
Rotterdam Convention	India is a signatory.	The Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides promotes responsible trade and transport of hazardous materials, empowering the undersigned countries to prioritise human health and environmental sustainability.[57]

Treaty	India's Status	Details
Stockholm Convention	India is a signatory.	The Stockholm Convention on Persistent Organic Pollutants (POPs) is a global treaty that oversees the production, use, trade, release, and storage of hazardous, long-lasting chemicals, with the ultimate goal of curbing their production.[58]
Delivery Systems		
Missile Technology Control Regime (MTCR)	India is a member.	The MTCR is a multilateral export control regime that aims to prevent the proliferation of missile technology capable of delivering weapons of mass destruction (WMDs). India joined the MTCR in 2016. India's membership in the MTCR aligns with its broader non-proliferation goals and enhances its standing as a responsible state in the global arms control community.[59]

Source: Author's own, from various sources

Domestic Strategic Framework in India

India has so far resisted forming an overarching and publicly available national security strategy, especially concerning CBRN response and deterrence. Instead, the country has a myriad of governing tools that together address CBRN risks, nuclear and radiological threats, and nuclear and radiological deterrence.

Table 2: India's Governing Tools for CBRN Risks

Tool	Description	Gaps
Weapons of Mass Destruction		
Weapons of Mass Destruction and their Delivery Systems (Prohibition of Unlawful Activities) Act, 2005[60]	The Act prohibits the development, production, stockpiling, and transfer of WMDs in chemical, biological, radiological, and nuclear explosives. It further prohibits the financing and facilitation of such activities. The Act is heavily influenced by and aligns the international treaties and agreements regarding non-proliferation and disarmament, reinforcing India's stance against the proliferation of WMD.	The Act does not highlight a specific body in charge of oversight. There is also a significant focus on prohibition, but prevention methods, mitigation methods, and awareness schemes do not have the same space as in many of the Acts in this field.
Radiological and Nuclear Governing Tools		
India's Cold Start Doctrine[61]	India's military strategy has been centred on an orthodox offensive doctrine, shaping its approach in past wars and crises. Doctrinal innovations like Cold Start have only optimised this approach. India's strategic environment has evolved since 1999. Nuclear deterrence reduces the likelihood of major wars but increases military coercion below the war threshold. The dominance of the orthodox offensive doctrine has skewed India's military strategy towards preparing for large conventional wars, leaving it poorly equipped for more probable scenarios short of war.[62] The doctrine relies on the existing BWC and CWC to relate risks and does not highlight policy requirements and deterrence strategies in case of attributed attacks.	The continued emphasis on this doctrine limits the Indian military's effectiveness as a national policy tool. The doctrine has inadvertently driven rivals like Pakistan and China to adopt more destabilising strategies, such as Pakistan's tactical nuclear weapons and China's land grabs. The lack of a periodic strategic review, resistance to change within the military, and weak civilian leadership have hindered necessary reforms. Given the changing nature of threats, including the increased salience of nuclear and other non-conventional weapons, India should prioritise CBRN defence. This focus is crucial for preparing the military to handle a broader range of threats and ensuring the safety and security of the nation in an increasingly complex strategic environment.

Tool	Description	Gaps
India's Nuclear Doctrine[63]	India's nuclear doctrine is centred on its "No First Use" policy and the promise of massive retaliation in the event of a nuclear attack. The doctrine emphasises credible minimum deterrence.[o,64] India's nuclear doctrine focuses on "massive retaliation" to an attack. While this was previously highlighted as a nuclear attack, it has been modified to mean any significant attack. India has also quoted the "option to retaliate with nuclear weapons if India or its forces are attacked by chemical or biological weapons", further highlighting that a nuclear response is not limited to a nuclear attack.	India's doctrine emphasises massive retaliation in response to any nuclear attack. However, there is a lack of clarity on what constitutes "massive" and whether this approach is proportional to smaller-scale nuclear attacks or other attacks in the realm of CBRN. The doctrine's focus on massive retaliation might limit India's ability to manage escalation in a controlled manner. There is a gap in having credible, calibrated responses that could help control the escalation ladder and prevent a full-scale nuclear exchange. The nuclear doctrine seems isolated from its conventional military doctrine. There is limited integration or discussion on how the two will operate together in times of conflict.
Nuclear and Radiological Governance Ecosystem	The Atomic Energy Act of 1962 is the foundational law, empowering the central government to regulate nuclear and radiation technologies. The Atomic Energy (Radiation Protection) Rules, 1971, and Safe Disposal of Radioactive Wastes Rules, 1987, ensure the safe handling of radiation and disposal of nuclear waste. India also has the Radiation Protection Rules, 2004.[65] The proposed Nuclear Safety Regulatory Authority (NSRA) Bill, 2011 aims to enhance regulatory oversight by replacing the existing Atomic Energy Regulatory Board (AERB) with an independent authority.[66]	The Indian nuclear energy and weapons ecosystem is well governed and has minimal gaps. One such gap is the lack of an early warning or detection system. Nuclear facilities are usually fragmented, with different materials stored in different locations to avoid accidental leaks, theft, or attacks. Adding a cybersecurity element in databasing these factions and triggering an EWS system if certain requirements are not met can further enhance the system.

o Hinging on the No First Use policy and the capability of retaliation, the goal of credible minimum deterrence is to convince other nations that the cost of attacking India with nuclear weapons would be unviable.

Tool	Description	Gaps
Radiological and Nuclear Detection and Management Systems	The Central Industrial Security Force (CISF) is trained in radiation protection measures, including using protective gear and implementing protocols for safely handling and disposing of radioactive materials.[67] India has implemented stringent measures to ensure the safety and security of its nuclear facilities and materials. It has also developed comprehensive plans for responding to nuclear emergencies, including drills and exercises to test the readiness of military and civilian agencies. These plans cover scenarios ranging from nuclear accidents to deliberate attacks.[68] The Department of Atomic Energy (DAE) has established Radiation Emergency Response Centres (RERCs) and set up Mobile Radiation Detection Systems (MRDS) in police stations across major cities. They have also formed Quick Reaction Teams (QRTs) at all nuclear power stations and installed portal radiation monitors at key airport cargo hubs and ports in India. Additionally, the National Disaster Management Authority (NDMA) is equipped with detection and response capabilities, though they currently have limited presence.[69]	The impact of cybersecurity risks on plants, vulnerable points such as ports, and staff with access to nuclear plants is yet to be fully incorporated into India's nuclear approach.[70]

Tool	Description	Gaps
Chemical Agents Governing Tools		
Chemical Weapons Convention Act, 2000[71]	India is a signatory to the CWC and, inspired by this, formed the Chemical Weapons Convention Act of 2000 and destroyed its chemical weapons stockpile. The policy prohibits the use of chemical weapons and commits to international chemical disarmament efforts. The Act highlights the powers of different levels of authority, including the Central Government and the National Authority Chemical Weapons Convention (NACWC), the Centre's power to deny search requests by the CWC, and the Centre's power to secede from the convention.	The Act is comprehensive and well applied. However, it is outdated in its considerations of technological updates and the potential of low-cost chemical manufacturing that can go unmonitored.

Tool	Description	Gaps
Chemical Detection and Management Procedures	India has developed and deployed chemical detection systems to identify chemical warfare agents. Both military and civilian agencies use these systems to monitor potential chemical threats.[72] The Indian Armed Forces has chemical protective suits, masks, and decontamination equipment. These resources are regularly updated and tested to ensure their effectiveness in chemical warfare. Specialised military and disaster response forces are trained in chemical decontamination procedures, including using decontamination agents and equipment to neutralise chemical contaminants.[73] Despite having laws on chemical management, the National Action Plan on Chemical Industrial Disaster Management (NAP-CIDM) has been finalised as the roadmap for responses by the NDMA.[74]	There is a significant shortfall in effective chemical detection systems, with many being outdated, and India lacks the capacity for even the standard recommended mass chemical decontamination during emergencies.[75]
Biological Agents Governing Tools		
Biological Weapons Policy Regime	As a signatory to the BWC, India is committed to prohibiting the development, production, and use of biological weapons. The policy also includes efforts to enhance biosecurity and biosafety.[76]	India currently lacks a singular titular policy or law overseeing biosecurity and biosafety. Instead, it relies on the BWC and its biosafety ecosystem to govern leakages or attacks.[77]

Tool	Description	Gaps
Biological and Environmental Detection and Management Systems	India has different Acts and governing bodies that oversee biological safety and security in the country.[78] It has also invested in biological detection systems that identify potential biological threats, such as pathogens, in the environment. These systems are integrated with public health surveillance networks to provide early warnings about biological attacks or outbreaks. India is engaged in ongoing research to develop new vaccines, diagnostics, and treatments for potential biological threats, enhancing its ability to respond to emerging infectious diseases and bioterrorism.	While India has invested in real-time bio-detectors, there is still a gap in availability and accessibility, particularly for field use. This gap further contributes to the capacity and capability of ground-level workers and primary healthcare systems, which often lack integrated disease surveillance and reporting mechanisms. While addressed by the Indian Disease Surveillance Project (IDSP), this still needs improvement.[79]
Disaster Management Governing Tools		
National Disaster Management Policy	The National Disaster Management Authority (NDMA) has guidelines for managing CBRN emergencies, with a focus on preparedness, response, and recovery during an incident.	The NDMA is yet to increase its efforts in public awareness and disaster prevention. Currently, efforts are focused on disaster mitigation. A realignment of the strategy will be more effective for CBRN security and safety umbrellas.

Tool	Description	Gaps
Defensive Preparedness Policy	India has established dedicated training centres for CBRN defence, where military personnel and first responders are trained in CBRN detection, protection, and decontamination techniques. These centres also conduct joint exercises with international partners to enhance interoperability. Regular CBRN drills and simulations are conducted to test the preparedness of military and civilian agencies. These exercises often involve complex scenarios that simulate the use of CBRN weapons in both military and civilian contexts. India's armed forces have specialised training programs for units tasked with CBRN defence. These programmes focus on advanced skills, such as operating CBRN detection equipment, medical response to CBRN casualties, and managing contaminated environments.	India's CBRN defence strategy includes close coordination with civil authorities, including local governments, hospitals, and emergency services. This ensures a comprehensive and integrated response to CBRN incidents, minimising casualties and damage. India's civil defence agencies conduct public awareness campaigns to educate the population on CBRN risks and the appropriate actions to take during a CBRN incident. These campaigns are crucial for ensuring that the public is informed and prepared. India invests in developing indigenous technologies for CBRN defence. These include advanced detection systems, protective materials, and decontamination agents tailored to India's needs. India's research institutions collaborate with universities, research organisations, and the private sector to drive innovation in CBRN defence. This collaborative approach ensures that India stays at the forefront of CBRN technology development. India actively participates in international research initiatives to enhance CBRN defence capabilities. This includes collaborations with countries and organisations.

Tool	Description	Gaps
Environmental Policies	In addition to policies and tools, India uses environmental policies on air, water, and disposal systems to monitor any outliers that may indicate the development or stockpiling of CBRN agents. The Air (Prevention and Control of Pollution) Act was enacted in 1981 and amended in 1987 to regulate toxic emissions, including those from industrial sources.[80] The amendments granted State Boards the authority to establish emission standards and enforce penalties for non-compliance. Under this Act, the Central Pollution Control Board (CPCB) implements the National Ambient Air Quality Monitoring Programme (NAMP), which monitors specific pollutants like sulphur oxide and nitrogen oxide and publishes annual standards and trends.[81] The Water (Prevention and Control of Pollution) Act, enacted in 1974 and amended in 1988, outlines industries' responsibilities to prevent pollutants and emissions from contaminating water bodies.[82] The Solid Waste Management Rules, 2016, were introduced to regulate local bodies' management of organic, inorganic, and chemical waste.[83]	Contamination from tanker deliveries, lakes, and wells poses severe risks to public health at minimum, but improper disposal of CBRN agents can also extend to safety and security issues. This will include trash and industrial waste in water bodies and soil, exacerbating environmental contamination. Large open landfills in urban centres reflect inadequate waste-management policies, leading to further environmental degradation and increased risks of chemical and biological contamination in surrounding areas. An example of this is in the improper handling of Cobalt-60 in the Mayapuri incident.

Source: Author's own, using various open sources

Although India lacks a CBRN deterrence and security strategy, it has a well-formed ecosystem of CBRN policies. Existing gaps may be addressed by the upcoming NSS through a CBRN-specific section or a CBRN strategy. Such a strategy would have to highlight intelligence and surveillance and military capabilities to respond to surveyed threats, implement civil defence measures to protect the civilian population during a CBRN attack, and invest in research and development to advance CBRN detection, protection, and decontamination technologies.[84] These focus areas could draw on the NATO's core principles on CBRN response,[85] which includes medical research to develop vaccines and treatments for potential biological threats. The gaps are discussed below.

Inter-Agency Communication and Coordination

One of the most significant challenges in CBRN deterrence is the need for effective inter-agency coordination. CBRN approaches are governed by various regulations and management systems. India has some nodal agencies for the CBRN areas, including the Ministry of Environment, Forest and Climate Change; Ministry of Health and Family Welfare; Department of Biotechnology; Ministry of Science; and Department of Atomic Energy. However, these agencies have different priorities besides CBRN security. Therefore, an overlapping crisis with differing protocols can lead to inefficiencies. A single nodular authority will help streamline decision making, awareness schemes, processes of implementation, and responses to threats.

Additionally, operational integration of CBRN detection and response technologies must be considered. Various agencies may have access to advanced tools and data, but integrating these resources into a cohesive operational framework is complex. For instance, real-time data from CBRN sensors must be shared across multiple platforms to ensure that all stakeholders have a unified understanding of the threat environment. However, technical compatibility issues and data silos often prevent seamless integration, reducing the overall effectiveness of response efforts. A significant challenge in India's lack of a CBRN strategy is the lack of a single document to refer to in crises for outcomes and protocols.

Cybersecurity and Communication

Inter-agency communication will need to be supported by cybersecurity measures. During crises, the supply chain for critical CBRN response equipment, including personal protective gear, decontamination agents, and portable diagnostic tools, can be disrupted. The 2017 WannaCry ransomware attack on the National Health Services (NHS) in the United Kingdom[p] highlights the outcome of such attacks on critical infrastructure. In a 2013 cyberattack on the Saudi Aramco chemical plant in Saudi Arabia, threat actors deleted large amounts of data in the plant.[86] Similar threats in India could have devastating consequences, and lead to potential theft, leak, or physical infiltration.[87]

Such disruptions can delay response times and reduce the overall effectiveness of deterrence measures.[88] These response times, mainly monitored through cybercommunications, add another layer of risk to cybersecurity. Technological advances should be used to enhance communication systems.[89] To address this, a robust cybersecurity framework is required that protects critical CBRN infrastructure. Investments in advanced cybersecurity measures, including threat-detection systems and regular security audits, are essential to safeguard against potential cyber threats. CBRN facilities must integrate comprehensive cybersecurity protocols to mitigate risks. These frameworks need to be adapted to different critical infrastructure but must include the following two segments:

- **Security measures:** These can include encryption, multi-factor authentication, and intrusion-detection systems. However, such security measures cannot overlook existing gaps in monitoring, such as the transport of critical materials between protected labs and factories.

- **Training and response:** Regular cybersecurity training for personnel and simulations of cyber-physical attacks can help prepare for potential breaches. Cybersecurity must evolve to include cybersecurity for individual staff and potential radicalisation beyond mitigating hackers from accessing critical infrastructure.

p The attackers encrypted data on infected systems and demanded ransom payments in Bitcoin. Many NHS systems were paralysed, leading to the cancellation of medical appointments, the diversion of emergency services, and the disruption of communication between healthcare providers. See: https://pubmed.ncbi.nlm.nih.gov/28584047/

Including Technological Growth in CBRN Governance

AI and Machine Learning (ML) are transforming CBRN detection by enhancing the ability to analyse vast amounts of data quickly and accurately. AI-driven systems can identify patterns in sensor data that might be missed by human operators, improving the speed and accuracy of threat detection. ML algorithms are also being used to predict the dispersion of hazardous substances in various environmental conditions, aiding in the rapid deployment of countermeasures.[90,91] Autonomous robotics in CBRN detection is another area of rapid development. Drones and ground-based robots with advanced sensors can enter contaminated areas to conduct surveillance and gather data without risking human lives. These robots can map contamination zones, sample air and soil, and even deploy countermeasures, providing invaluable support in managing CBRN incidents.[92] For example, in 2020, AI-driven drones were deployed to monitor radiation levels around the Chernobyl exclusion zone in Ukraine. These drones used advanced sensors to gather data on radioactive contamination and used ML algorithms to analyse the dispersion of radiation, helping authorities monitor ongoing environmental threats decades after the initial disaster.[93]

While technological advancements usually determine future detection systems, they can contribute to delivery systems and prevent accurate detection. Private-sector participation in building a knowledge base, mainly to stay updated with newer technologies that may manifest as threats, is crucial in any CBRN strategy.

Public Awareness and Preparedness

Public awareness and preparedness for CBRN threats are critical components of national defence, yet often overlooked. Many populations remain unaware of the nature of CBRN threats and the appropriate actions to take in the event of an incident. The NDRF in India has attempted to increase community awareness programmes, though these tend to focus on natural disasters.[94] There is a crucial need for awareness and reporting

mechanisms that engage diverse stakeholders, from staff working in critical infrastructure, such as laboratories, to those in leadership positions. This approach should promote cross-level reporting and address threats across industries. For instance, individuals in biosafety labs must be informed about potential threats that could arise in chemical or nuclear facilities.

Implementing such awareness initiatives will enhance the reporting of suspicious activities and leaks that could indicate a broader threat. There also needs to be increased focus on biological and chemical attacks and how these have different impacts on different genders and age groups. Additionally, accessible reporting mechanisms need to be included.

Collaborative Approach in Research, Development, and Innovation

The competition for research and innovation in defence technologies has historically driven innovation but has also led to strategic tensions. An example is China's space race, which was significantly influenced by the Wolf Amendment.[q,95] This competitive stance pushed China to independently accelerate its space program, leading to rapid advancements but also contributing to geopolitical tensions.[96]

As witnessed in international treaties, specifically related to biosecurity, collaboration in security can have more global benefits. Collaborative efforts in biosecurity, such as international partnerships for vaccine development and global disease surveillance networks, the trade of chemical agents, and delivery systems development, need to be highlighted in any national security strategy that discusses India's collaborative approach.

Incorporating public-private partnerships is also critical. The development of technologies, including chemical agents and biotechnology, and advancements in nuclear spaces, is more pronounced in the private sector compared to the public sector. In India, a programme managed by the Defence Research and Development Program aims to encourage

q A US legislative measure restricting NASA's collaboration with China. This amendment was made to deter China from using shared constellations such as GPS for their defence and security from 2011 going forward.

private-sector participation in defence research; the Defence Innovation Organisation (DIO) manages the Innovations for Defence Excellence (iDEX)[r] programme, aimed at supporting core developments in aerospace and defence.[97] These initiatives currently focus more on aerospace. The absorption of similar programmes in CBRN will help an overarching strategy make valuable contributions to deterrence.

Addressing the challenges and gaps in CBRN deterrence is critical for improving national and global security. Technological and logistical challenges, coordination and integration issues, gaps in public awareness, and funding constraints all pose significant hurdles. Moreover, the balance between competitive and collaborative approaches in R&D will shape the future of CBRN defence. By recognising and addressing these challenges, nations can enhance their preparedness and response capabilities, ensuring more resilient defence against CBRN threats.

r iDEX launched the Defence India Start-up Challenge to help create technology prototypes for defence and security. See: https://idex.gov.in/

Leveraging Multilateral Collaborations

India has participated in different multilateral alliances within Asia, including the South Asian Association for Regional Cooperation (SAARC). This alliance has held summits discussing energy, biotechnology, technology, and innovation. The alliance had its last summit in 2014 in Kathmandu, after which it has not continued discussions under the SAARC banner.[98]

Another important dialogue is the Association of Southeast Asian Nations (ASEAN). While not a member of the ASEAN, India has frequently interacted with the grouping under the ASEAN-India Strategic Partnership that spans 30 dialogues.[99] The ASEAN has a Network of ASEAN CBR Defence Experts (CBR Network),[100] which was last convened in 2018 and addresses defence responses and the handling of biological, chemical, and radiological materials.[101] Despite these multilateral alliances, the conversations around CBRN security in the region have stunted due to the stagnation of the alliances or India's removed participation.

India can address international collaboration in CBRN security under two banners: the Quadrilateral Security Dialogue, an already established alliance that India has actively participated in, and by establishing an Indo-Pacific NATO.

Quadrilateral Security Dialogue

India is at a crucial juncture to leverage the Quadrilateral Security Dialogue (Quad)—a strategic forum comprising India, the US, Japan, and Australia.[102] India's engagement in the Quad provides an opportunity to build a multilateral approach to CBRN deterrence, integrating its key partners' technological, strategic, and diplomatic capacities. Each member nation brings distinct capabilities and perspectives that can significantly enhance collective action against CBRN threats.

The United States

India's CBRN partnership with the US has been fundamental to its broader defence and strategic relationship. This collaboration is anchored in joint military exercises, technology sharing, and expertise in emergency response.

Leveraging Multilateral Collaborations

A cornerstone of this cooperation is the US-India Civil Nuclear Agreement (2008), which facilitated civilian nuclear collaboration and established robust non-proliferation safeguards to ensure that nuclear cooperation does not contribute to the spread of WMDs.[103] The partnership has expanded to include joint research and development in CBRN technologies, offering India access to cutting-edge innovations, and to empower indigenous organisations in detection, protection, and response mechanisms. Regular exercises like Yudh Abhyas and collaboration in training in CBRN response strategies have reinforced the readiness to address regional and global threats.[104,105,106]

Australia

India and Australia have participated in joint military exercises, such as AUSINDEX, where CBRN risk management has been a focal point, especially in maritime security.[107] This collaboration enables both nations to exchange best practices in managing the threat of WMDs and related technologies.

Australia's expertise in biosecurity and regional influence via the Australia Group on the trade and monitoring of chemical and biological agents can align closely with India's priorities in enhancing domestic CBRN resilience.[108,109] India can strengthen regional disarmament efforts by working with Australia and ensuring better coordination during CBRN emergencies.

Japan

Japan's strong advocacy for nuclear disarmament and non-proliferation is driven by its historical experience as the only nation to have suffered a nuclear attack. This makes it a critical partner in India's broader CBRN agenda. Additionally, Japan's technological prowess in early warning systems and disaster preparedness in the wake of nuclear accidents adds a layer of expertise that India can integrate into its CBRN risk-reduction strategies.[110]

Leveraging Multilateral Collaborations

India's active engagement within the Quad offers a multilateral force multiplier effect in the global CBRN domain. India can build a more robust CBRN strategy through increased collaboration and aligning its national capabilities with the expertise and strategic interests of the US, Japan, and Australia. The Quad's multilateral platform would further enable shared intelligence, joint exercises, and technological exchanges that can significantly reduce the risk of CBRN incidents.

An 'Indo-Pacific NATO'

India has historically been distant from strategic multilateral alliances, such as NATO, instead prioritising strategic autonomy, as evidenced by NATO Plus and India's limited participation in the alliance.[111]

India has developed regional security mechanisms and partnerships, such as with the Quad, resulting in it being referred to as the de-facto Indo-Pacific NATO.[112] However, recent attempts by the US, through its Indo-Pacific Security Strategy, to include India in NATO activities and attempt to build an "Asia-Pacific version of NATO" could have significant implications for India's geopolitical stance and security framework.[113]

In September 2024, the desire to establish an 'Indo-Pacific NATO' was echoed by Japan's former defence minister Shigeru Ishiba. In a discussion about the growing military challenges posed by China and its partnership with Russia, Ishiba stated that Japan is seeking collaborations with countries such as South Korea, the Philippines, Australia, and possibly the US.[114] By aligning with the US-led initiative, India is positioning itself within a broader regional security architecture aimed at counterbalancing China's influence, which has already garnered China's disapproval.[115] Canada's defence minister Bill Blair suggests that an Indo-Pacific alliance similar to NATO would differ in priorities from the NATO itself due to the region's diverse strategic interests.[116] If India were to take the lead, it could influence this alignment to increase militarisation and the prioritisation of CBRN readiness as part of India's broader security strategy, ensuring that it is prepared to face threats from state and non-state actors in a more contentious regional environment. Further, including the scope of such multilateral collaborations in a CBRN strategy and leveraging such regional alliances will help enhance India's strategic partnerships and military collaborations with like-minded countries, particularly in regional security.

Policy Recommendations for Strengthening CBRN Deterrence

India has already established regulations on different CBRN areas and aligned itself to international conventions and governance tools. However, these initiatives can be enhanced by an overarching CBRN strategy. A comprehensive CBRN strategy must ensure individual technological, strategic, and public-facing initiatives to address the multifaceted challenges posed by CBRN threats. The following policy recommendations are aimed at enhancing a singular national CBRN security strategy rather one that relies on an ecosystem of regulations.

Technological Enhancements

The rapid evolution of CBRN threats necessitates investments in the latest detection and response technologies. This includes advancing multi-spectral imaging, AI-driven analytics, portable diagnostic tools, and autonomous robotics. These technologies can provide early warning, enhance situational awareness, and improve the precision and speed of response efforts. Emerging technologies cannot be ignored, as they can have dual-use implications in all areas of CBRN threats and can contribute to enhanced cyber risks, increasing the need for cybersecurity and industrial resilience. Regular updates to relevant technologies should be prioritised through allocated funding, and private-sector participation in indigenous technology innovation and inclusion should be encouraged.

Strengthening Coordination and Chain of Command

Effective CBRN deterrence requires seamless coordination between multiple agencies, including the military, law enforcement, emergency services, and public health organisations. While the NRDF, SRDF, NRDA, and CISF are regular participants in exercises, local police and other civil authorities also need to be included in training sessions to create a reliable hierarchy or chain of command. Standardised protocols and communication platforms that enable real-time data-sharing and decision-making across agencies should be established to streamline response efforts. Regular joint training exercises should be conducted to ensure that all stakeholders are familiar with these protocols and can operate cohesively in a crisis. This is

particularly useful when a CBRN threat occurs in a non-conflict area or time and needs to be contained.

International Collaboration

A CBRN strategy must leverage existing multilateral alliances and create space for future collaboration. Strengthening international collaboration is crucial for effective deterrence. India actively participates in multilateral forums such as the UN, the Conference on Disarmament, and the Non-Aligned Movement (NAM) to promote its views on CBRN non-proliferation and disarmament.[117] India has used these platforms to advocate for states' rights to pursue peaceful nuclear energy exploration while adhering to non-proliferation commitments. India has also pushed for the negotiation of a Fissile Material Cut-off Treaty (FMCT) that would prohibit the production of fissile material for nuclear weapons.[118] India has also taken the lead in regional security initiatives aimed at preventing the proliferation of CBRN weapons, including engaging with South Asian neighbours to promote confidence-building measures and reduce the risk of CBRN escalation in the region. India's proactive approach to rekindle forums like the SAARC or establish an Indo-Pacific NATO reflects its commitment to regional stability.[119]

However, this approach can be enhanced by leveraging the Quad and establishing a more robust regional alliance in Southeast Asia, enhancing intelligence sharing, joint research initiatives, and coordinated response strategies with key allies and international organisations. Countries should also collaborate to harmonise CBRN-related regulations and standards, facilitating cross-border cooperation and ensuring a unified global response to CBRN incidents, specifically those that may be non-war incidents perpetrated by non-state actors. The balance between independence and deterrence and international collaboration is important for India to maintain.

Public Awareness Campaigns

Public awareness and preparedness are critical components of CBRN deterrence. Governments should develop comprehensive education

programmes that inform the public about CBRN risks and the appropriate actions to take in the event of an incident. These programmes can include incorporation in school curriculum and workshops in local policing authorities and hospitals. These programmes should be tailored to different communities and should take into consideration local risks, vulnerabilities, and differences in how symptoms may present in response to chemical or biological contamination. Additionally, CBRN community preparedness initiatives, such as drills and workshops, should be organised to build resilience and ensure that citizens can respond effectively to CBRN threats, specifically those who may live around vulnerable conflict areas or industrial areas.

R&D Investments

Investing in R&D for cutting-edge defence technologies is essential to avoid emerging CBRN threats. This includes funding for basic and applied research in areas such as synthetic biology and nanotechnology, which have the potential to revolutionise CBRN detection and response. Here, too, public-private partnerships can help accelerate innovation and ensure that new technologies are rapidly transitioned from the lab to the field.

Implementing these policy recommendations can significantly enhance governments' CBRN deterrence capabilities. Technological enhancements, improved coordination, international collaboration, public awareness campaigns, increased R&D investment, and a focus on disaster management are critical components of a robust CBRN defence strategy. These measures will strengthen national security and contribute to global efforts to prevent and mitigate the devastating effects of CBRN threats.

Conclusion

India's approach to CBRN security reflects its commitment to evolving threats, driven by both historical incidents and the increasingly complex global security environment. Developing a robust CBRN strategy has become essential to national security, requiring not just traditional defence mechanisms but also cutting-edge technological enhancements and multilateral cooperation. There is a need for increased public awareness, the inclusion of the private sector, and the creation of a nodal authority to oversee all processes. Such a strategy must also be accompanied by an investment in technologies that enhance detection and response and enable different agencies to interact.

At the international level, India's diplomatic engagements in multilateral forums like the UN, the Conference on Disarmament, and NAM have positioned the country as an active member in CBRN non-proliferation. However, leveraging partnerships like the Quad and expanding Southeast Asian alliances will be crucial for the future of CBRN security in the region. By implementing these strategic policy recommendations, India can safeguard its national security and play a pivotal role in shaping a safer, more secure global environment.ORF

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