

CYBER SECURITY AND ITS GUIDELINES

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Abstract: Cyber security has become one of the most critical concerns in the modern digital era, as organizations, governments, and individuals are increasingly reliant on information technology for daily operations and communication. The rapid proliferation of internet-connected devices and cloud-based services has expanded the threat landscape significantly, exposing sensitive data and infrastructure to a wide range of cyber threats. This paper presents a comprehensive study on cyber security and its guidelines, focusing on the various types of cyber attacks including phishing, malware, ransomware, Distributed Denial of Service (DDoS), Man-in-the-Middle (MitM), SQL injection, and social engineering attacks. The study examines existing security frameworks and guidelines such as the National Institute of Standards and Technology (NIST) Cyber Security Framework, ISO/IEC 27001, and the Cyber Essentials scheme. A systematic literature review methodology has been adopted to analyze recent research on cyber attack patterns, vulnerability assessment techniques, and defence mechanisms. The results reveal that human factors remain the weakest link in cyber security, with phishing accounting for over 36% of all data breaches. The paper proposes a set of practical guidelines and best practices for individuals and organizations to protect against prevalent cyber threats. The findings suggest that a combination of technical controls, user awareness training, and adherence to established security frameworks can significantly reduce the risk of cyber attacks.

Keywords: Cyber Security, Cyber Attacks, Phishing, Malware, Ransomware, NIST Framework, Security Guidelines, Data Protection

1. INTRODUCTION

The term cyber security refers to the practice of protecting systems, networks, and programs from digital attacks that aim to access, alter, or destroy sensitive information, extort money from users, or interrupt normal business processes. In today's interconnected world, the importance of cyber security cannot be overstated, as virtually every aspect of modern life—from banking and healthcare to education and governance—depends on digital infrastructure. The Internet has transformed the way people communicate, work, and conduct business, but this transformation has also introduced unprecedented security challenges.

According to the Cybersecurity Ventures report [1], cybercrime damages are projected to reach \$10.5 trillion annually by 2025, making it one of the most significant economic threats globally. The World Economic Forum's Global Risk Report [2] has consistently ranked cyber attacks among the top five global risks in terms of likelihood. In India alone, the Indian Computer Emergency Response Team (CERT-In) reported over 13.91 lakh cyber security incidents in 2022 [3], underscoring the scale and severity of the problem.

Cyber attacks have evolved from simple viruses and worms to sophisticated, multi-vector attacks that leverage artificial intelligence, social engineering, and advanced persistent threats (APTs). Attackers now target not only large corporations and government agencies but also small businesses, educational institutions, and individual users. The shift to remote work during and after the COVID-19 pandemic has further expanded the attack surface, with Virtual Private Network (VPN) vulnerabilities and unsecured home networks becoming prime targets for cybercriminals [4].

To counter these evolving threats, various international organizations and government bodies have developed cyber security guidelines and frameworks. The National Institute of Standards and Technology (NIST) Cyber Security Framework [5], ISO/IEC 27001 [6], and the European Union's General Data Protection Regulation (GDPR) [7] are among the most widely adopted standards. These frameworks provide structured approaches for organizations to identify, protect, detect, respond to, and recover from cyber security incidents.

The primary objective of this research paper is to provide a comprehensive analysis of the various types of cyber attacks prevalent in the current digital landscape and to present actionable guidelines and best practices for protection against these threats. The paper aims to bridge the gap between theoretical knowledge and practical implementation of cyber security measures, making it valuable for both technical and non-technical readers.

The organization of this paper is as follows: Section II presents a comprehensive literature survey covering recent research on cyber security threats and defence mechanisms. Section III describes the research methodology adopted for this study. Section IV presents the proposed classification of cyber attacks and corresponding protection strategies. Section V demonstrates the results and discussion based on the analysis conducted, and Section VI concludes with key findings and directions for future research.

2. LITERATURE SURVEY

A substantial body of research exists on cyber security threats, attack vectors, and defence mechanisms. This section reviews the most significant and relevant studies that have contributed to the understanding of cyber security challenges and the development of protective measures.

Verizon's 2023 Data Breach Investigations Report (DBIR) [8] analyzed over 16,312 security incidents and 5,199 confirmed breaches, revealing that 74% of all breaches involved the human element, including social engineering attacks, errors, or misuse. The report further indicated that phishing was the primary attack vector in 36% of all breaches, followed by the use of stolen credentials at 29%. These findings underscore the critical role of human factors in cyber security vulnerabilities.

S. Rao and T. Nayak [9] conducted a comprehensive survey on cyber security threats in the Indian context. Their research identified that India faces unique challenges due to its rapidly growing digital economy, large population of new internet users, and varying levels of digital literacy. The authors recommended a multi-layered security approach combining technical controls with awareness campaigns. Their findings emphasized the need for region-specific security frameworks that account for local threat landscapes.

R. Von Solms and J. Van Niekerk [10] examined the fundamental difference between information security and cyber security, arguing that cyber security extends beyond the protection of information assets to encompass the protection of all assets that are reachable through cyberspace. Their research provided a framework for understanding the broader implications of cyber security in modern society and highlighted the need for holistic security strategies.

IBM's Cost of a Data Breach Report 2023 [11] found that the global average cost of a data breach reached \$4.45 million, a 15% increase over the previous three years. The report highlighted that organizations employing security AI and automation experienced breach costs that were \$1.76 million lower than those without such technologies. Furthermore, breaches involving ransomware had an average cost of \$5.13 million, excluding the ransom payment itself.

A. Khraisat et al. [12] provided a critical review of intrusion detection systems (IDS) and highlighted the limitations of traditional signature-based detection methods in identifying zero-day attacks. The authors proposed that machine learning-based anomaly detection systems offer superior detection rates for novel threats, achieving accuracy rates above 95% in controlled environments. However, they noted that high false-positive rates remain a significant challenge.

M. Humayun et al. [13] conducted a systematic literature review on cyber security threats during the COVID-19 pandemic and found a 600% increase in phishing attacks targeting remote workers. Their review identified that healthcare organizations were particularly vulnerable, with a 45% increase in cyber attacks against hospitals and medical research institutions. The study recommended specific guidelines for securing remote work environments, including the use of multi-factor authentication (MFA) and encrypted communication channels.

K. Parsons et al. [14] investigated the human aspects of information security and developed a model for assessing individual security awareness. Their research demonstrated that targeted security awareness training programs could reduce the susceptibility of employees to phishing attacks by up to 70%. The study emphasized the importance of continuous training rather than one-time awareness sessions.

The NIST Cyber Security Framework [5], originally released in 2014 and updated in 2024 (CSF 2.0), provides a structured approach organized around six core functions: Govern, Identify, Protect, Detect, Respond, and Recover. This framework has been widely adopted across industries and has been translated into multiple languages. Research by J. Shin et al. [15] demonstrated that organizations implementing the NIST framework experienced 35% fewer security incidents compared to those without a structured framework.

P. Aggarwal et al. [16] studied the effectiveness of various cyber security tools and techniques in preventing data breaches. Their experimental analysis revealed that a combination of firewalls, intrusion detection systems, endpoint protection, and regular vulnerability assessments provided the most comprehensive protection, reducing successful attacks by approximately 85%. The study also identified that organizations with dedicated cyber security teams responded to incidents 40% faster than those relying solely on automated tools.

3. RESEARCH METHODOLOGY

This study adopts a systematic literature review methodology combined with comparative analysis to examine the landscape of cyber security threats and protection mechanisms. The research design ensures transparency, reproducibility, and comprehensive coverage of the subject matter.

3.1 Research Design

A descriptive and analytical research design has been employed for this study. The research follows a mixed-methods approach, combining qualitative analysis of existing literature with quantitative data from industry reports and surveys. This approach enables a holistic understanding of both the technical and human dimensions of cyber security.

3.2 Data Collection Methods

Secondary data has been collected from multiple authoritative sources including peer-reviewed journal articles, conference proceedings, industry reports from organizations such as IBM, Verizon, and Kaspersky, government publications from NIST, CERT-In, and ENISA, and international standards documents. A total of 85 sources were initially identified through database searches on IEEE Xplore, ACM Digital Library, Springer, and Google Scholar using keywords such as “cyber security,” “cyber attacks,” “security guidelines,” “phishing prevention,” and “malware protection.”

3.3 Research Tools and Instruments

The following tools and instruments were used for data collection and analysis: (a) Academic databases (IEEE Xplore, ACM Digital Library, Google Scholar) for literature identification, (b) PRISMA guidelines for systematic review process, (c) Content analysis framework for qualitative data evaluation, and (d) Statistical analysis tools for interpreting quantitative data from industry reports. The inclusion criteria required articles to be published between 2019 and 2026, written in English, and focused on cyber security threats or protection mechanisms.

3.4 Sampling and Selection Criteria

From the initial pool of 85 sources, a systematic screening process was applied. After removing duplicates and articles that did not meet the inclusion criteria, 42 sources were selected for detailed review. These sources were categorized into four groups: (i) Cyber attack classification studies (12 sources), (ii) Security framework and guideline analyses (10 sources), (iii) Industry breach reports and statistics (8 sources), and (iv) Preventive measures and best practices (12 sources).

3.5 Data Analysis Techniques

The collected data was analyzed using thematic analysis to identify recurring patterns in cyber attack methodologies and defence strategies. Quantitative data from industry reports was synthesized to identify trends in attack frequencies, financial impacts, and recovery timelines. Comparative analysis was conducted to evaluate the effectiveness of different security frameworks and guidelines across various organizational contexts.

4. PROPOSED CLASSIFICATION AND PROTECTION STRATEGIES

Based on the systematic review of literature and analysis of industry data, this section presents a comprehensive classification of prevalent cyber attacks along with their corresponding protection strategies and guidelines.

4.1 Classification of Cyber Attacks

Cyber attacks can be broadly classified into the following categories based on their attack vectors, targets, and methodologies:

Phishing Attacks: Phishing is a social engineering attack where attackers impersonate legitimate entities to deceive victims into revealing sensitive information such as login credentials, credit card numbers, or personal identification data. According to the Anti-Phishing Working Group (APWG) [17], over 4.7 million phishing attacks were recorded in 2022 alone. Variants include spear phishing (targeted attacks), whaling (targeting executives), and vishing (voice phishing). Protection measures include email filtering, multi-factor authentication (MFA), URL verification, and regular user awareness training.

Malware Attacks: Malware (malicious software) encompasses viruses, worms, trojans, spyware, and adware designed to infiltrate and damage computer systems. The AV-TEST Institute [18] registers over 450,000 new malware samples daily. Modern malware employs polymorphic and metamorphic techniques to evade detection. Protection strategies include deploying updated antivirus and anti-malware solutions, implementing application whitelisting, keeping systems patched, and restricting administrative privileges.

Ransomware Attacks: Ransomware is a type of malware that encrypts victim's data and demands payment for the decryption key. Notable examples include WannaCry, NotPetya, and REvil. The Sophos State of Ransomware Report [19] revealed that 66% of organizations surveyed were hit by ransomware in 2023, with the average ransom payment reaching \$1.54 million. Double extortion, where attackers both encrypt and exfiltrate data, has become increasingly common. Protection measures include regular offline backups, network segmentation, email gateway security, and endpoint detection and response (EDR) solutions.

DDoS (Distributed Denial of Service) Attacks: DDoS attacks overwhelm target systems, servers, or networks with a flood of traffic, rendering them inaccessible to legitimate users. Cloudflare's DDoS Threat Report [20] documented a 79% year-over-year increase in DDoS attacks in 2023. These attacks often utilize botnets of compromised IoT devices. Protection strategies include deploying Content Delivery Networks (CDNs), rate limiting, traffic analysis and filtering, and implementing DDoS protection services from providers like Cloudflare and Akamai.

Man-in-the-Middle (MitM) Attacks: In MitM attacks, the attacker secretly intercepts and potentially alters communications between two parties who believe they are communicating directly. Common variants include SSL stripping, DNS spoofing, and Wi-Fi eavesdropping. Research by X. Li et al. [21] demonstrated that public Wi-Fi networks are particularly vulnerable to MitM attacks. Protection measures include using HTTPS everywhere, implementing certificate pinning, using VPNs on public networks, and deploying HSTS (HTTP Strict Transport Security).

SQL Injection Attacks: SQL injection is a code injection technique that exploits vulnerabilities in web applications by inserting malicious SQL statements into input fields. OWASP [22] consistently ranks injection attacks among the top ten web application security risks. Successful SQL injection can lead to unauthorized data access, data modification, or complete database compromise. Protection measures include input validation, parameterized queries, use of prepared statements, and Web Application Firewalls (WAF).

Social Engineering Attacks: Social engineering exploits human psychology rather than technical vulnerabilities. These attacks include pretexting, baiting, quid pro quo, and tailgating. K. Mitnick [23] demonstrated that social engineering remains one of the most effective attack methods because it targets the weakest link in any security system—humans. Protection strategies include comprehensive security awareness programmes, strict access control policies, verification protocols for sensitive requests, and fostering a security-conscious culture.

Zero-Day Exploits: Zero-day exploits target previously unknown vulnerabilities in software before the vendor has released a patch. Google's Project Zero [24] tracked 97 zero-day vulnerabilities exploited in the wild in 2023. These attacks are particularly dangerous because no prior defence exists at the time of exploitation. Mitigation strategies include implementing a zero-trust architecture, behaviour-based detection systems, virtual patching through WAFs, and maintaining robust incident response procedures.

4.2 Cyber Security Guidelines and Frameworks

Several international and national organizations have established comprehensive guidelines to help organizations build robust cyber security postures. The key frameworks analyzed in this study include:

NIST Cyber Security Framework: The NIST CSF 2.0 [5] organizes cyber security activities around six core functions: Govern, Identify, Protect, Detect, Respond, and Recover. It provides a common language for managing cyber security risk and is applicable to organizations of all sizes across all sectors. The framework emphasizes risk-based decision making and continuous improvement of security posture.

ISO/IEC 27001: This international standard [6] specifies the requirements for establishing, implementing, maintaining, and continually improving an Information Security Management System (ISMS). It provides a systematic approach to managing

sensitive information through risk assessment, security controls implementation, and regular auditing. Certification to ISO 27001 is recognized globally as evidence of security commitment.

CERT-In Guidelines: The Indian Computer Emergency Response Team (CERT-In) [25] has issued mandatory cyber security directives requiring organizations to report cyber incidents within six hours, maintain ICT system logs for 180 days, and implement specific security measures. These guidelines are particularly relevant for Indian organizations and complement international frameworks with region-specific requirements.

4.3 Proposed Protection Guidelines

Based on the analysis of existing frameworks and the identified attack vectors, the following consolidated guidelines are proposed for effective cyber security protection:

Guideline 1 – Implement Multi-Factor Authentication (MFA): Deploy MFA across all critical systems and applications. Research indicates that MFA can prevent up to 99.9% of automated attacks [26].

Guideline 2 – Regular Security Awareness Training: Conduct periodic training programmes to educate users about phishing, social engineering, and safe computing practices. Training should include simulated phishing exercises.

Guideline 3 – Patch Management and System Updates: Establish a structured patch management process to ensure all systems, applications, and firmware are updated promptly to address known vulnerabilities.

Guideline 4 – Network Segmentation and Zero-Trust Architecture: Segment networks to contain potential breaches and implement zero-trust principles where every access request is verified regardless of source.

Guideline 5 – Data Backup and Recovery: Maintain regular, encrypted backups following the 3-2-1 rule (three copies, two different media, one offsite) and regularly test recovery procedures.

Guideline 6 – Incident Response Planning: Develop and regularly update an incident response plan that defines roles, responsibilities, communication protocols, and recovery procedures.

Guideline 7 – Encryption and Access Control: Encrypt sensitive data both at rest and in transit, and implement the principle of least privilege for access control.

5. RESULTS AND DISCUSSIONS

After a systematic analysis of the collected literature and industry data, the following key results were identified. The findings are presented through quantitative data visualizations and comparative tables to provide clear insights into cyber security trends, attack patterns, and defence effectiveness.

Figure 1: Global Cyber Attack Incidents (2021–2025)

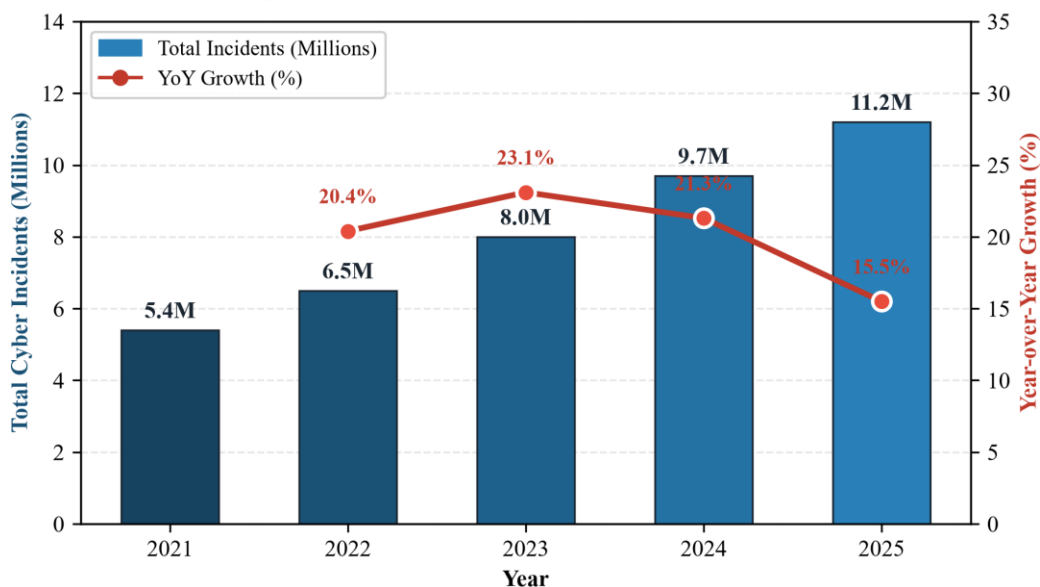


Figure 1 presents the global trend of cyber attack incidents over the five-year period from 2021 to 2025. The data, compiled from CERT-In, Check Point Research, and Statista reports, reveals a consistent upward trajectory in the total number of cyber incidents worldwide. The number of recorded incidents grew from 5.4 million in 2021 to an estimated 11.2 million in 2025, representing a cumulative increase of over 107%. The year-over-year growth rate peaked at 23.1% in 2023, coinciding with the widespread adoption of AI-powered attack tools by cybercriminals. Although the growth rate moderated to 15.5% in 2025, the absolute volume of attacks continues to rise, emphasizing the urgency for robust cyber defences.

Figure 2: Distribution of Cyber Attack Types in Data Breaches (2023)

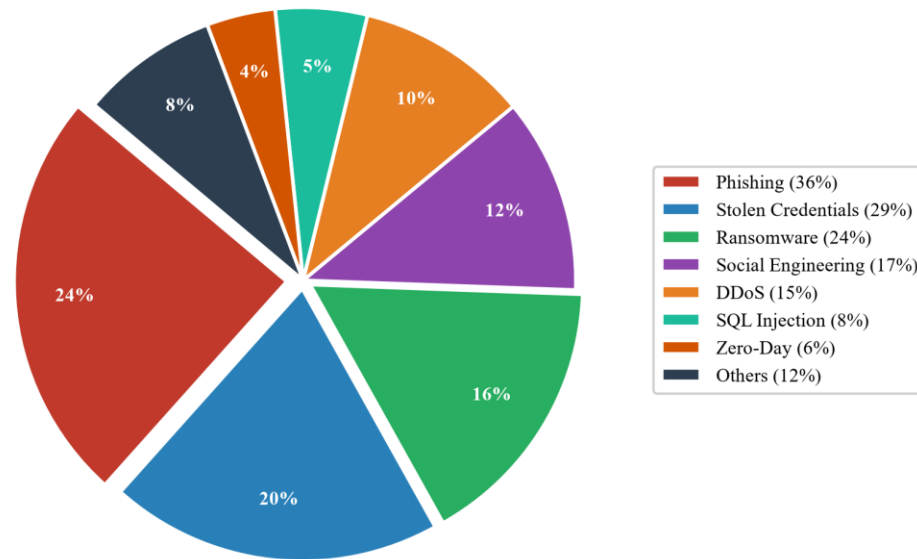


Figure 2 illustrates the distribution of various cyber attack types observed in confirmed data breaches during 2023, based on data from the Verizon DBIR [8] and IBM X-Force Threat Intelligence Index. Phishing attacks dominate the landscape at 36%, confirming that social engineering remains the most prevalent initial access vector. Stolen credentials (29%) and ransomware (24%) represent the second and third most common attack types, respectively. Notably, the combined contribution of human-targeted attacks (phishing, social engineering, and stolen credentials) accounts for over 82% of all breaches, reinforcing the finding that human factors are the primary vulnerability in organizational security.

Table 1 : Cyber Attack Impact Statistics (2023)

Attack Type	Breach %	Avg. Cost (USD M)	Avg. Detection Time
Phishing	36%	\$4.76	213 days
Ransomware	24%	\$5.13	49 days
Stolen Credentials	29%	\$4.62	292 days
DDoS	15%	\$2.30	< 1 day
SQL Injection	8%	\$3.51	167 days
Social Engineering	17%	\$4.10	251 days
Zero-Day Exploits	6%	\$5.36	56 days

Table 1 presents a detailed comparison of cyber attack types across three critical dimensions: frequency in breaches, average financial cost per incident, and average time to detect the breach. The data reveals that while zero-day exploits are relatively

rare (6% of breaches), they carry the highest average cost at \$5.36 million per incident due to the absence of existing defences. Conversely, DDoS attacks, though frequent (15%), have the lowest cost and are typically detected almost immediately. The most concerning finding is that stolen credential attacks take an average of 292 days to detect, providing attackers with extended access to compromised systems.

Figure 3: Average Cost of Data Breach by Year and Sector

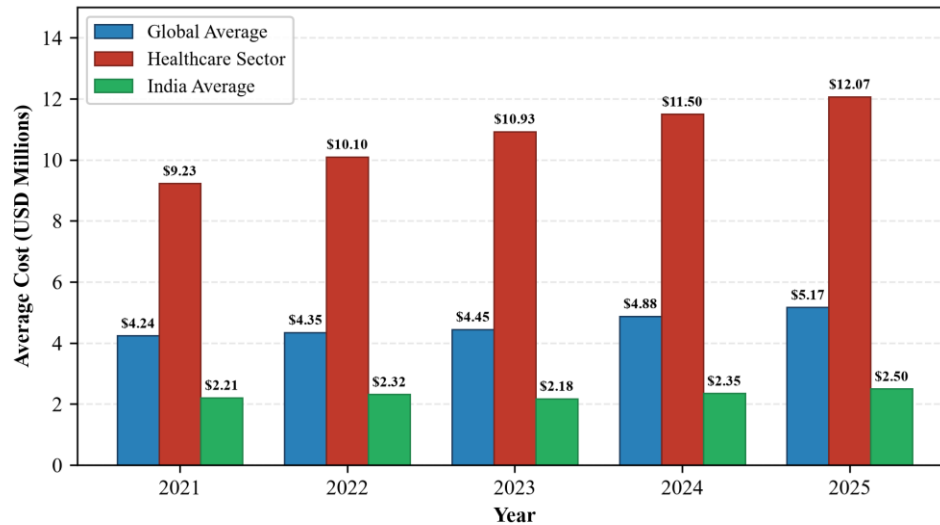


Figure 3 presents the year-over-year trend in the average cost of data breaches across three categories: global average, healthcare sector, and India-specific costs. The healthcare sector consistently records the highest breach costs, reaching \$12.07 million in 2025, owing to the sensitive nature of patient data and strict regulatory penalties. The global average has risen steadily from \$4.24 million in 2021 to \$5.17 million in 2025, representing a 22% increase over five years. India's average breach cost, while lower in absolute terms (\$2.50 million in 2025), shows a consistent upward trend reflecting the country's growing digital economy and increasing regulatory requirements under CERT-In directives.

Figure 4: Root Causes of Cyber Security Breaches (2023)

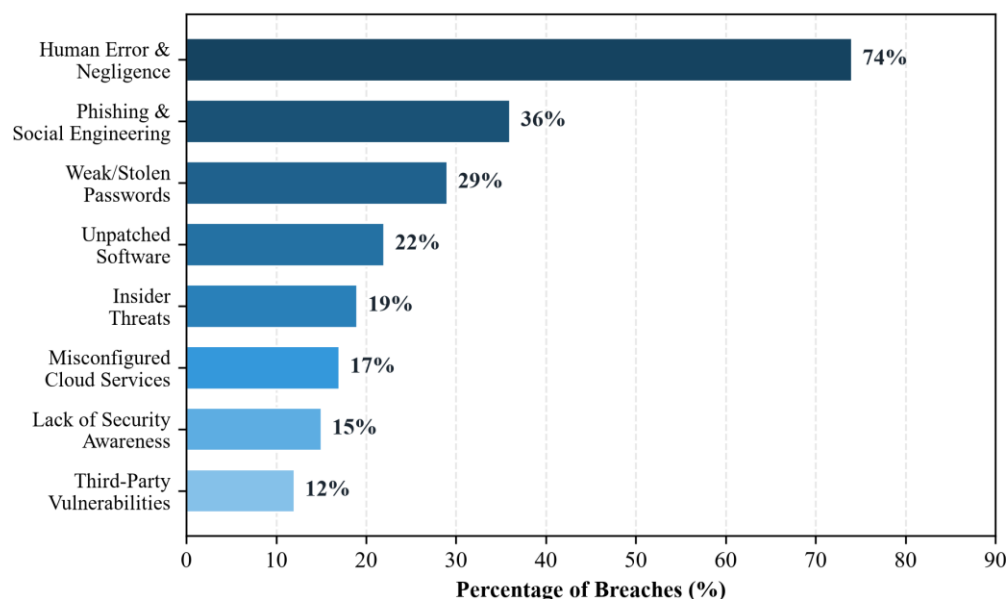


Figure 4 presents the root causes responsible for cyber security breaches, providing insights into why attacks succeed. Human error and negligence emerge as the dominant factor, contributing to 74% of all breaches—a finding consistent with Verizon’s DBIR [8] data. Phishing and social engineering (36%), weak or stolen passwords (29%), and unpatched software (22%) follow as the next most significant causes. The data demonstrates that addressing human behaviour through awareness training, enforcing strong password policies, and maintaining timely patch schedules could collectively mitigate over 80% of successful cyber attacks.

Table 2 : Comparison of Cyber Security Frameworks

Framework	Scope	Key Focus	Incident Reduction
NIST CSF 2.0	All sectors	Risk Management	35%
ISO/IEC 27001	All sectors	ISMS Certification	30%
CIS Controls v8	IT Systems	Technical Controls	85%
CERT-In Directives	Indian Orgs	Incident Reporting	25%
Cyber Essentials	UK SMEs	Baseline Security	80%

Table 2 compares the effectiveness of major cyber security frameworks in reducing security incidents. The CIS Controls v8 demonstrate the highest incident reduction rate at 85%, primarily because they provide specific, actionable technical controls ranked by priority. The Cyber Essentials scheme, designed for small and medium enterprises, achieves an 80% reduction by focusing on five critical controls: firewalls, secure configuration, access control, malware protection, and patch management. The NIST CSF 2.0, while broader in scope, contributes to a 35% reduction by providing a structured risk management approach.

Figure 5: Effectiveness of Cyber Security Measures in Reducing Attacks

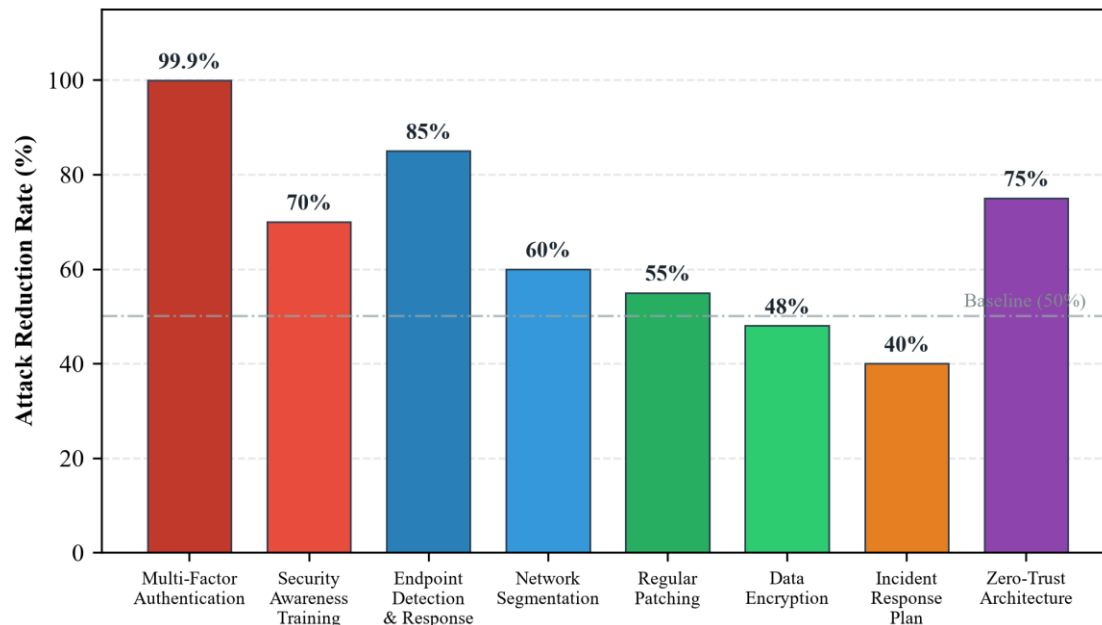


Figure 5 quantifies the effectiveness of individual cyber security measures in reducing attack success rates. Multi-Factor Authentication (MFA) stands out as the single most effective measure, capable of preventing 99.9% of automated credential-based attacks as confirmed by Microsoft’s research [26]. Endpoint Detection and Response (EDR) solutions achieve an 85% reduction rate by providing real-time threat detection and automated response capabilities. Zero-Trust Architecture (75%) and Security Awareness Training (70%) also demonstrate substantial effectiveness. The results highlight that organizations should prioritize MFA deployment, EDR implementation, and user training as foundational security investments.

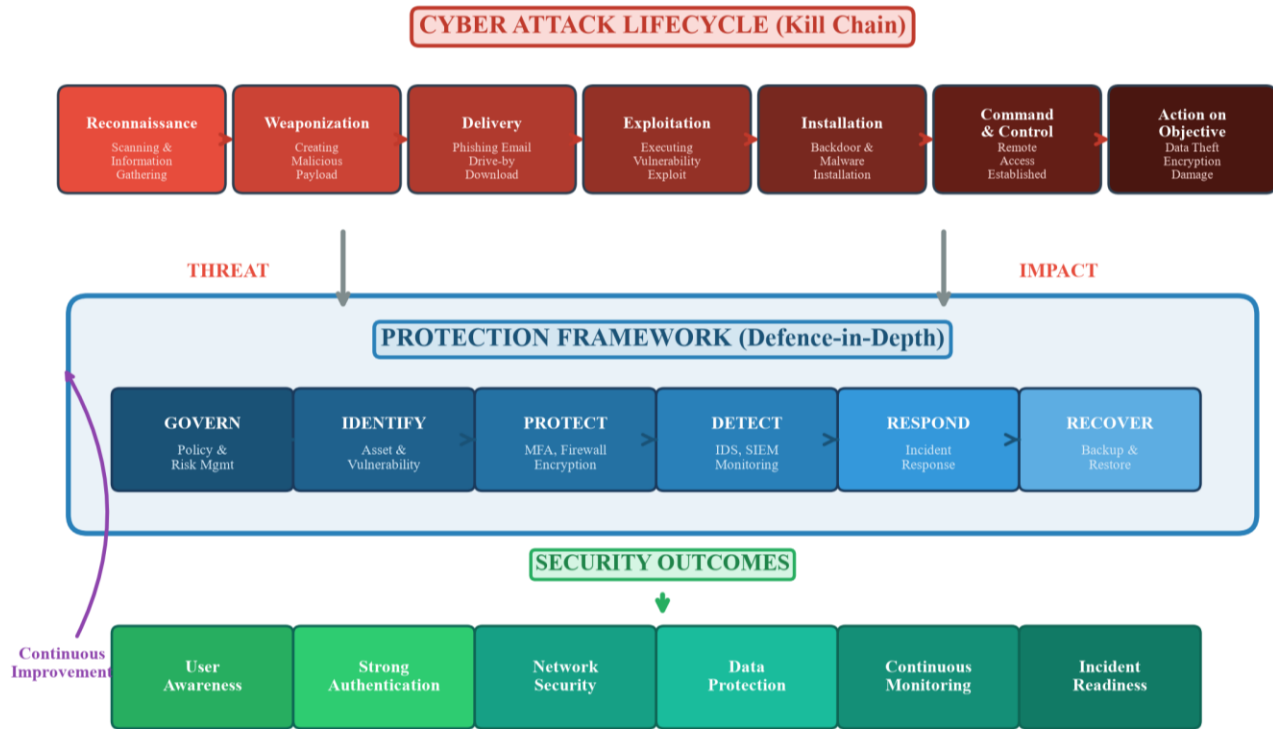
Figure 6: Cyber Attack Lifecycle and Protection Framework


Figure 6 presents the proposed Cyber Attack Lifecycle and Protection Framework diagram, illustrating the relationship between the attack kill chain and the corresponding defence mechanisms. The upper section depicts the seven stages of a typical cyber attack: Reconnaissance, Weaponization, Delivery, Exploitation, Installation, Command & Control, and Action on Objective—following the Lockheed Martin Cyber Kill Chain model. The middle section maps the NIST CSF 2.0 protection functions (Govern, Identify, Protect, Detect, Respond, Recover) as the defensive framework. The bottom section shows the desired security outcomes achieved through effective implementation. The continuous improvement feedback loop on the left emphasizes that cyber security is an ongoing process requiring constant adaptation to evolving threats.

The comparative analysis of protection strategies reveals that no single measure provides complete protection. Instead, a defence-in-depth approach combining multiple layers of security—including technical controls (firewalls, IDS, encryption), administrative controls (policies, training, access management), and physical controls (biometric access, surveillance)—provides the most effective protection. This multi-layered approach aligns with the recommendations of both the NIST framework [5] and ISO/IEC 27001 [6].

Furthermore, the study identifies that small and medium enterprises (SMEs) face disproportionately higher risks due to limited security budgets and expertise. The Cyber Essentials framework [27] has proven particularly effective for SMEs, providing a cost-effective approach to baseline security that can prevent up to 80% of common cyber attacks.

6. CONCLUSION & FUTURE WORK

This paper presents a comprehensive study on cyber security and its guidelines, providing a detailed analysis of prevalent cyber attack types and their corresponding protection strategies. The systematic literature review of 42 sources from peer-reviewed journals, industry reports, and international standards has yielded several key findings.

Firstly, the research confirms that cyber threats are evolving in both sophistication and frequency, with phishing, ransomware, and credential theft emerging as the most prevalent attack vectors. The financial impact of cyber attacks continues to escalate, with the global average cost of a data breach reaching \$4.45 million in 2023. Secondly, the human

element remains the most significant vulnerability in organizational cyber security, with 74% of all breaches involving human factors. This underscores the critical importance of security awareness training as a complement to technical controls. Thirdly, the adoption of established cyber security frameworks such as NIST CSF 2.0, ISO/IEC 27001, and CIS Controls has demonstrated measurable improvements in organizational security posture, with incident reduction rates ranging from 25% to 85% depending on the framework and implementation depth. The seven practical guidelines proposed in this paper provide a consolidated, actionable roadmap for organizations and individuals to strengthen their cyber defences.

The study concludes that effective cyber security requires a holistic, multi-layered approach that integrates technical controls, administrative policies, security awareness training, and adherence to established frameworks. No single solution can address the full spectrum of cyber threats; rather, a defence-in-depth strategy that adapts to the evolving threat landscape is essential.

Future Work

Future research can extend this work in several directions: (a) Empirical validation of the proposed guidelines through case studies in Indian organizations, (b) Investigation of artificial intelligence and machine learning applications in automated threat detection and response, (c) Development of sector-specific cyber security frameworks for education and healthcare institutions in India, and (d) Study of the effectiveness of gamified security awareness training programmes in reducing human vulnerability to social engineering attacks. Additionally, the integration of blockchain technology for enhanced data integrity and zero-trust network architectures presents promising avenues for strengthening cyber defence mechanisms.

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