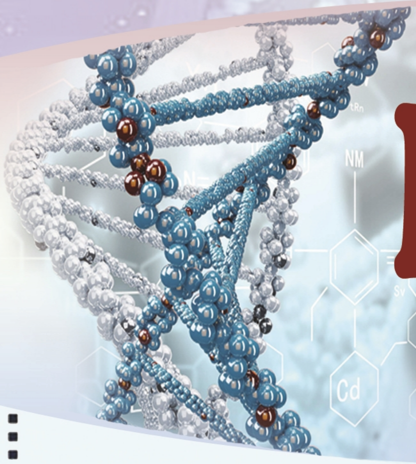

Bio-Letters

Year: 2023
Volume: 6, Issue: 1

Jointly published by

Institutional Biotech Hub
and
Bioinformatics Centre
GURUCHARAN COLLEGE

Re-accredited 'A' grade by NAAC

Silchar, Cachar, Assam

www.gccbiotech.ac.in

Newsletter Name	:	Bio-Letters
Year of Publication	:	2023
Volume/ Issue	:	6 (1)
Contents	:	9 articles, 11 pages
Published by	:	Institutional Biotech Hub and Bioinformatics Centre, Gurucharan College, Silchar
City/State/Country	:	Silchar, Assam, India
Website	:	https://www.gccbiotech.ac.in/

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mRNA Vaccine Technology Expands Beyond COVID-19

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In a significant advancement in biotechnology, the mRNA vaccine technology that played a critical role in fighting COVID-19 is now being utilized to address a wider range of diseases. Researchers are investigating the potential of mRNA vaccines in treating various infectious diseases, cancers, and genetic disorders.

mRNA vaccines work by instructing cells to produce proteins that trigger an immune response without the need for live virus particles. This method not only enhances safety but also allows for rapid development and adaptability. Recent studies have shown promising results in using mRNA technology to create vaccines for diseases such as influenza, HIV, and Zika virus (Guo et al., 2023).

Furthermore, the flexibility of mRNA technology is being applied in oncology. Personalized mRNA cancer vaccines, designed to elicit an immune response against specific tumor antigens, are showing encouraging outcomes in early clinical trials (Lin et al., 2023). This approach could revolutionize cancer treatment by enabling highly individualized therapies that more effectively target cancer cells.

Additionally, mRNA technology is being explored for its potential in treating genetic disorders. By delivering mRNA that encodes functional versions of defective proteins, researchers aim to correct genetic abnormalities at the molecular level, offering hope for conditions such as cystic fibrosis and muscular dystrophy (Robert et al., 2023; Allen et al., 2023).

The expansion of mRNA vaccine technology marks a pivotal moment in biotechnology, highlighting its versatility and transformative potential across various medical fields. As research progresses, mRNA-based therapies are poised to become powerful tools in the fight against numerous diseases, significantly impacting global health.

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CRISPR-Cas9 Advancements in Genetic Therapy

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In the dynamic field of biotechnology, the CRISPR-Cas9 gene-editing technology has taken center stage with a groundbreaking advancement in genetic therapy. Researchers have recently unveiled a modified CRISPR system, termed "CRISPR-Cas9 Prime Editing," which promises unprecedented precision in genetic modifications (Choi et al., 2022)

Prime Editing enhances the traditional CRISPR-Cas9 method by allowing not just the cutting of DNA but also the precise insertion and deletion of nucleotides. This leap forward reduces the risks of unintended genetic mutations and increases the accuracy of genetic repairs. Early trials have demonstrated remarkable success in correcting genetic mutations responsible for conditions like sickle cell anemia and cystic fibrosis (Superson et al., 2024).

The potential applications of this refined technology extend beyond human genetic diseases. Agricultural biotechnology stands to benefit enormously, with Prime Editing enabling the development of crops with improved resistance to diseases and environmental stressors, thereby addressing global food security challenges (Xu et al., 2020).

This breakthrough not only marks a significant stride in the quest for more effective genetic therapies but also paves the way for future innovations in the broader realm of biotechnology. As research progresses, CRISPR-Cas9 Prime Editing holds the promise of transforming how we approach the treatment of genetic disorders, ultimately improving the quality of life for millions worldwide.

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Synthetic Biology Creates Sustainable Bioplastics

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A groundbreaking achievement in biotechnology has emerged from the field of synthetic biology, offering a promising solution to the global plastic pollution crisis. Researchers have developed an innovative method to produce sustainable bioplastics using engineered microbes, which could significantly reduce reliance on traditional petroleum-based plastics.

The process involves genetically modifying bacteria to synthesize polyhydroxyalkanoates (PHAs), a type of biodegradable polymer. Unlike conventional plastics, PHAs can decompose naturally in the environment, minimizing the ecological impact of plastic waste. This development addresses the urgent need for eco-friendly alternatives as the world grapples with the environmental consequences of plastic pollution.

Recent studies have shown that these engineered microbes can be optimized to produce PHAs efficiently and cost-effectively, using renewable resources such as agricultural waste and carbon dioxide. This not only makes the production process more sustainable but also creates a circular economy by converting waste materials into valuable products (Balla et al., 2024). The versatility of PHAs extends their application beyond packaging materials to include medical devices, agricultural films, and even textiles. This innovation opens up a new frontier in material science, where sustainable bioplastics could replace conventional plastics in numerous industries, contributing to a more sustainable future (Kumar et al., 2023).

As synthetic biology continues to advance, the production of bioplastics from engineered microbes represents a significant leap towards reducing plastic waste and mitigating climate change. This breakthrough underscores the potential of biotechnology to create solutions that are both environmentally friendly and economically viable, paving the way for a greener planet.

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AI-Powered Drug Discovery Accelerates Therapeutic Development

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A significant breakthrough in biotechnology has emerged with the integration of artificial intelligence (AI) in drug discovery, revolutionizing the way new therapies are developed. AI-powered platforms are now capable of analyzing vast datasets to identify potential drug candidates at unprecedented speeds, reducing the time and cost associated with traditional drug discovery methods.

One of the most notable advancements comes from the use of machine learning algorithms to predict how different compounds will interact with biological targets. By processing millions of data points from chemical libraries, genetic information, and clinical trial results, AI models can identify promising drug candidates in a fraction of the time it takes using conventional methods (Vora et al., 2023).

Recent successes include the identification of new antibiotics to combat resistant bacteria and potential treatments for diseases like Alzheimer's and Parkinson's. For instance, AI algorithms have identified novel compounds that can inhibit key proteins involved in these diseases, providing a starting point for further experimental validation and clinical testing (Noazi 2023).

Moreover, AI-driven drug discovery is enhancing personalized medicine. By analyzing individual genetic profiles, AI can help tailor treatments to a patient's specific genetic makeup, increasing the efficacy and reducing the side effects of therapies. This personalized approach holds promise for treating complex diseases such as cancer, where individual variability significantly impacts treatment outcomes (Mhatre et al., 2023).

The convergence of AI and biotechnology marks a transformative era in therapeutic development. By leveraging the power of AI, researchers can expedite the discovery of new drugs, bringing effective treatments to patients faster and more efficiently than ever before. This breakthrough not only accelerates the pace of medical innovation but also holds the potential to address some of the most challenging health issues of our time.

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Crosstalk of Antibiotic Stewardship and One Health Approach to Address Antimicrobial Resistance

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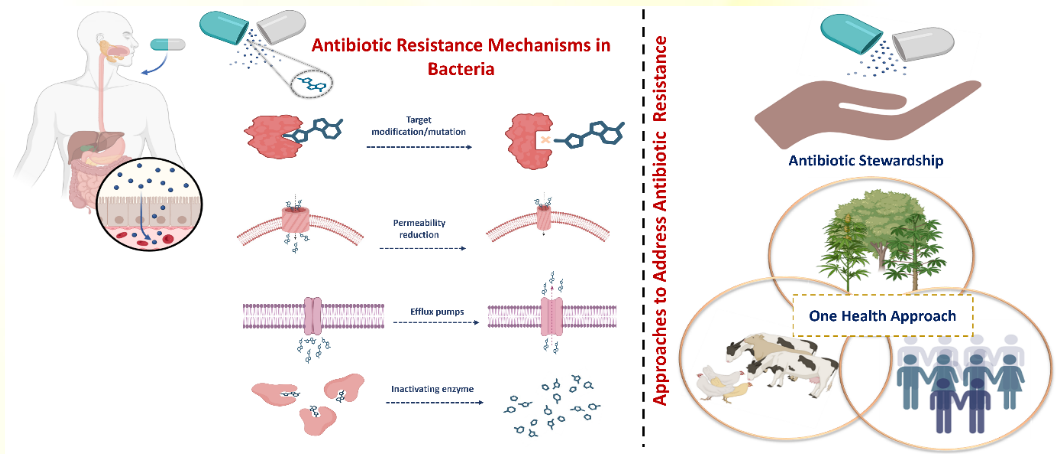
Antimicrobial resistance (AMR) is a critical global health issue that threatens the effectiveness of antibiotics, antifungals, antivirals and antimalarials. One of the major causes being the indiscriminate and overuse of third line antibiotics or drug of last resort which bottlenecks the treatment regime. As pathogens evolve to resist treatments, the efficacy of these drugs diminishes, leading to longer illnesses, higher healthcare costs, and increased mortality. The adaptability of the bacterial pathogens occurs predominantly through multiple processes like efflux pumps, mutations in drug targets, production of antibiotic degrading enzymes (β-lactamases), changes in membrane permeability of porin channels.



Antibiotic resistance mechanisms and approaches to address antibiotic resistance

Addressing AMR requires a holistic strategy, and the One Health approach, which integrates human, animal, and environmental health perspectives, is essential for a comprehensive response. According to the World Health Organization (WHO), at least 700,000 people die each year due to drug-resistant diseases. By 2050, this number could rise to 10 million deaths annually if no action is taken. The impact of AMR is so profound that it threatens to render common medical procedures, such as surgeries and chemotherapy, increasingly risky due to the potential for untreatable infections. The economic burden is also substantial, with increased healthcare costs stemming from longer hospital stays, more intensive care, and the need for more expensive medications. The economic cost of AMR could reach $100 trillion globally by 2050, with a significant impact on global GDP.

The One Health Approach

The One Health approach recognizes the interconnectedness of human, animal, and environmental health. By addressing AMR through this integrated perspective, it becomes possible to implement more effective and sustainable solutions.

Human Health: In the medical sector, antibiotic stewardship programs (ASPs) are extremely vital as these programs aim to optimize antibiotic use by ensuring that patients receive the right antibiotic at the right dose for the right duration. This reduces unnecessary antibiotic use and helps prevent the development of resistance. Education and training for healthcare providers, as well as public awareness campaigns, are crucial for promoting judicial usage of antibiotic use which includes prescribing narrow spectrum antibiotics unless extreme critical condition is encountered.

Animal Health: The use of antibiotics in animals is expected to increase by 67% by 2030 if no action is taken, further exacerbating the AMR problem. The agricultural and veterinary sectors also play a significant role in combating AMR. The use of antibiotics in livestock should be limited to therapeutic purposes, avoiding their use for growth promotion or disease prevention without veterinary oversight. Good animal husbandry practices, such as maintaining hygiene, proper nutrition and vaccination, can reduce the need for antibiotics. Proper action plans for veterinarians and farmers in accordance to national health policy would further ensure proper usage and administration of antibiotics.

Environmental Health*:* The environment acts as a reservoir for resistant microorganisms and antibiotic residues. Waste from pharmaceutical manufacturing, healthcare facilities, and agricultural runoff can introduce antibiotics into natural ecosystems, promoting the development and spread of resistance. Effective waste management practices, such as proper disposal of unused medications and treatment of wastewater, are essential. Monitoring environmental contamination and regulating antibiotic discharge are also critical steps.

Strategies for Antibiotic Stewardship

Combating AMR requires a multifaceted strategy that encompasses surveillance, regulation, research and education. Studies have shown that ASPs can reduce inappropriate antibiotic use by 30-50%, significantly decreasing the incidence of resistant infections. The Global Antimicrobial Resistance Surveillance System (GLASS) collects data from 66 countries, highlighting the widespread prevalence of AMR. Integrated surveillance systems can provide comprehensive data, helping to identify trends and guide interventions. This data is essential for informing policies and strategies to combat AMR. Regulatory agencies must collaborate internationally to harmonize standards and practices. The European Union banned the use of antibiotics as growth promoters in animal feed in 2006, leading to a significant reduction in antibiotic resistance in livestock.

The pharmaceutical industry is investing over $1 billion annually in research and development to combat AMR, yet only a few new antibiotics have been approved in the past decade. Investment in research is critical for developing new antibiotics, alternative treatments, and rapid diagnostic tools. Understanding the mechanisms of resistance and identifying novel targets for antimicrobial development are essential. Research should also focus on finding sustainable agricultural practices and new ways to reduce the environmental impact of antibiotics. Public awareness campaigns have successfully reduced antibiotic prescriptions by up to 20% in several countries, demonstrating the effectiveness of education in combating AMR. Raising awareness about AMR and the importance of antibiotic stewardship is fundamental. Educational campaigns targeting healthcare professionals, veterinarians, farmers, and the general public can promote responsible antibiotic use. Training programs and materials should emphasize the risks associated with inappropriate use and the benefits of adhering to stewardship principles.

Antibiotic stewardship and one health approach, as a core component of tackling AMR ensures the responsible use of antibiotics, preserving their effectiveness for future generations. Through vigilant surveillance, stringent regulation, dedicated research, and widespread education, we can mitigate the silent war of AMR and safeguard the efficacy of vital antimicrobial therapies.

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Neurodegenerative Proteins associated with Dementia

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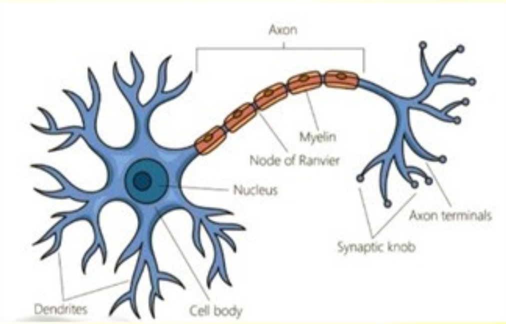
Introduction

Dementia describes a collection of brain diseases and their symptoms including memory loss, impaired judgement, personality change and inability to perform daily activities. Dementia can be caused due to various diseases, side effects of medicine, stroke, thyroid, brain tumor. The different types of Dementia are Alzheimer's disease, Vascular Dementia, Frontotemporal Dementia, Lewy Body Dementia, Dementia related diseases. It is generally seen in older adults (32% of people age 85, 17% of people age 75-85, 3% of people age 65-74) than younger ones . Alzheimer's disease is seen highest in Finland. It is currently the seventh leading cause of death .

Basic structure of Neuron



Neurons are made up of cell body , axon and dendrites. Dendrites carry signals from one neuron to other. The synaptic junction is where the messenger molecules are transferred. Neurons have three regions, message receiving end, a long hallway and a message sending end.

Functional proteomics of Tau and Amyloid protein

The molecular mechanisms underlying Alzheimer's disease are mainly associated with the aggregation of beta amyloid protein outside neurons and tau protein inside neurons .

Tau protein: Tau protein is found mostly in the messenger cells of our brain, called neurons and help in maintaining stability. For signal transduction, the signal must pass through the axon which is made of the microtubules that are stabilized by the Tau protein. People having memory loss are seen with elevated level of Tau where tau starts to build up and neurofibrillary tangles are formed, impacting the communication between brain cells and disrupt the balance.

Amyloid precursor protein (App): App is a protein found in the CNS which can be processed into healthy soluble protein and toxic amyloid beta protein . In healthy brain amyloid beta is cleared but in Alzheimer's disease it clumps forming oligomers and accumulating as plaques .

Tests for Dementia

Cognitive tests: Focus on things like memory, counting, reasoning, and language skills.

Neurological tests: Test the balance, reflexes and eye movements.

PET (positron emission tomography) scan: This shows the activity in the brain and can be used to check for a certain protein like amyloid .

Conclusion

The future study in biomarkers and blood based screening are helpful method for the diagnosis of Alzheimer's disease. The risk of Dementia can be decreased by being physically active.

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Harnessing Probiotics for Optimal Health and Well-being

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In recent years, the importance of gut health has gained significant attention in the scientific community and among the general public. Probiotics, which are live microorganisms that confer health benefits to the host, have been at the forefront of this research. The latest studies reveal promising insights into how probiotics can improve gut health and overall well-being. The gut microbiome, a complex community of microorganisms residing in the gastrointestinal tract, plays a crucial role in various bodily functions, including digestion, immune response, and even mental health. Disruptions to this delicate balance, known as dysbiosis, have been linked to numerous health conditions such as inflammatory bowel disease (IBD), irritable bowel syndrome (IBS), obesity, and even depression.

Recent research highlights the potential of probiotics to restore and maintain a healthy gut microbiome. A study published by Bonfrate et al. (2023) found that specific probiotic strains, such as *Lactobacillus rhamnosus* and *Bifidobacterium longum*, can significantly reduce symptoms of IBS by modulating gut flora and reducing inflammation. Participants who received these probiotics reported improved bowel regularity and reduced abdominal pain compared to the placebo group (Boonma et al., 2021). Another groundbreaking study demonstrated that a multi-strain probiotic supplement could enhance the efficacy of standard treatments for IBD. The study showed that probiotics not only helped in reducing inflammation but also promoted mucosal healing in patients with Crohn's disease and ulcerative colitis (Selvamani et al., 2022).

Furthermore, emerging evidence suggests that probiotics can impact mental health through the gut -brain axis. A randomized controlled trial found that supplementation with *Bifidobacterium bifidum* and *Lactobacillus helveticus* reduced symptoms of anxiety and depression in individuals with moderate to severe depression (Wallace and Milev, 2021). The study proposed that these probiotics might influence neurotransmitter production and reduce systemic inflammation, contributing to their mood-enhancing effects. These studies underscore the growing understanding of the gut microbiome's role in overall health and the potential of probiotics as a therapeutic tool. While the field is still evolving, the latest research provides a compelling case for incorporating probiotics into clinical practice and daily health regimens.

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Country Made Firearm's Type and Challenges in Investigation

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The widespread availability of country made firearms - or 'Desi-Kattas as they are known in street slang here - is a major threat to public order and policing throughout India. The country is home to the second-largest civilian population of privately held firearms world wide behind only US, In this backdrop, India is suffering from serious issue as many regions occupy as grey zone in respect of use of such firearms for commissioning crime particularly, by Uttar Pradesh and Bihar which are two most effected states from North India.

The Current State of Improvised Firearms

This creation and misinterpretation has relevance in the case of India, a country with one of the most stringent gun control laws coupled paradoxically to an unprecedented proliferation semi-industrial small arms sector." The illegal 'Desi-Kattas' account for about 85 % of firearm related murders in the country and UP & Bihar with more then two-thirds share - accounts almost exclusively however less frequent such incidents are reported from Northeast India.

Improvised firearms are also called country-made guns, pipe guns and zip gun. Most of these weapons are an improvised design and produced in make-shift workshops using basic items including but not limited to steel pipes, autocar scraps as well as standard commercial ammunition. Given how unregulated these guns are, it is no surprise that they can result in all kinds of erratic and dangerous behavior.

Expanding Violations; Incremental Challenges

Thus, it is only so long as conventional crimes - all the way to such non-conventional ones like terrorism/insurgency and organized criminal activities where (different sort of) improvised firearms are being misused. But as the use of these weapons is spread across jurisdictions, it becomes harder for investigators to coordinate in a cross-regional investigation and on account of the more than 50 lakh forensic cases pending at India's various forensic laboratories.

The less quality of manufacturing in improvised firearms, going from shotguns, pistols to pipe guns much more hazardously with frequent use. Its no real benefit, they are only good at short ranges and either have jamming issues or there ammo gets inconsistent due to service. This lack of consistency can make the job harder for forensic analysis as, depending on what random shapes and sizes come up in the various barrel choices available to a criminal sympathizer, you will end up with widely divergent ballistic results.

Forensic Analysis Methodology

Forensic analysis of homebuilt firearms is generally undertaken in the same way as for conventional weapons, but:

1. Test Firing and Ballistic Analysis: Detection of firing pin scratches, breejson.ch face marks and chamber impressions.

2. Barrel Inspection: Examining common barrel defects and inconsistencies that influence shot patterns, as well as projectile flight paths.

3. The term "identification" refers to identifying the make, model and caliber of a weapon via forensic evidence collected throughout the investigation.

4. Preservation of Evidence: Documentation maintaining the integrity and continuity trace evidence (evidence could include fingerprints, or paint residues)

5. Inductively Coupled Plasma Mass Spectrometry (ICP-MS)

6. scanning Electron Microscopy with Energy Dispersive X-ray Spectroscopy (SEM-EDX)

7. Integrated Ballistics Identification System (IBIS)

Forensic experts encounter a lot of challenging situations like safeguarding the forensically scrutinized evidence collected from the crime scene, establishing full-proof safeguards for chain of trace and addressing complex questions concerning typology in addition to functionality about gun involved.

The worrying issue of illegal and homemade firearms in India, which has close to 40 million firearm owners only that about a mere number of them possess licenses (6.3 million). The spread of these arms is also strongly related to organized crime, governmental corruption and weak enforcement structures. To counter this, it suggests a few steps:

1. Crackdown on Illegal Workshops: The authorities need to crush down on workshops making machines for these guns.

2. Enhancing Law Enforcement: Providing resources to improve police and forensic labs handling of firearm related crime.

3. Legislative Reforms: To push for stricter implementation of laws and to create independent vigilance department which would check compliance by various state governments & also, growth of the Illegal firearms Industry.

The function of improvised firearms is unreliable, and the construction less safe than that otherie personsepastica in liberaliori partepars. Given that they are widely used in criminal activities, a holistic approach including tighter regulations on their sale and usage stronger enforcement of regulation as well the coordination across law implementing agencies is needed. This, in turn would help India be a step closer to becoming safer and regulating its firearm-related problems better.

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Classification of Fingerprint Patterns

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Fingerprints are unique to each person, and they cannot be replicated easily (for example by refusing to scan a fingerprint) forensic scientists have studied them for nearly one hundred years. One such journey over different classification systems shows an interesting progression from the manual methods to increasingly advanced automated technologies.

In the beginning, it was the Henry Classification System developed by Sir Edward Henry in 19th century that initiated with fingerprint categorization. This system setting unique patterns of whorls on even and odd fingers give a pattern to identify number for classification fingerprints. It may have had limited application in its early days, but it was a huge step toward making fingerprint analysis standardized.

Introduction of Automated Fingerprint Identification Systems (AFIS) indicates a great advancement in the history all through late twentieth century. At any rate, it is clear that AFIS has changed the method of fingerprint classification by first bringing in minutiae points and ridge flow patterns to digitize them before submitting for identification. Forensic investigations became more efficient due to this technological advancement.

Finally, the development by Galton of a classification system that alphabetically enumerated all fingerprint types (loops, whorls and arches) served to further shape the identification process. The system, still in use by many historians today introduced a more detailed method where letters were assigned to types of patterns which gave a clearer and concise representation of any set of fingerprint.

Enhanced refinement was however achieved with The Sub Secondary Classification system which is Ridge count and the Major classification system focusing on detailed pattern analysis. These systems were theoretically significantly more precise when it comes to fingerprint categorization, taking into account specifics and increasing the certainty of identifications.

Fingerprint classification systems have gone from crude manual processes to complex automated methods over time, ultimately reflecting improvements in technology and forensic science. Although each system from Henry's system to contemporary AFIS (automated fingerprint identification systems) and beyond obviously comes with its own limitations, they collectively represent a means of identifying people that is still more accurate or efficient than any other method available for forensic applications. Taking stock of these advancements reveals the incredible strides in forensic tech, and exposes on-going demands for biometric identification to evolve.

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