

EXTENDED ABSTRACT



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Extended Abstract

GoldClear® Anti-acne Patch: Harnessing Natural Efficacy with Modern Drug Delivery for Acne Care

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ABSTRACT

Acne vulgaris is a common skin condition that affects millions worldwide, often leading to physical discomfort and psychological distress. Conventional treatments, typically in cream or gel form, can be sticky, unpleasant, and easily washed off, which reduces effectiveness and user compliance and potentially contributes to resistance issues. In recent years, natural plant extracts have gained popularity as alternative therapeutic agents due to their safety profile and multiple bioactive properties. This study focuses on developing an anti-acne patch, GoldClear®, infused with *Allamanda cathartica* (golden trumpet) leaf extract. The GoldClear® extract demonstrated rich phytochemical constituents, high efficacy, low cytotoxicity, and a favourable selectivity index, ensuring safe application on the skin. Incorporating this extract into a patch allows targeted delivery, enhancing its therapeutic action and minimizing systemic exposure. The *in vitro* study revealed that the GoldClear® patch exhibits potent bactericidal activity against *Propionibacterium acnes*, a key pathogen implicated in acne development, showing effectiveness comparable to tea tree oil gel. These findings highlight the potential of GoldClear® as a natural and effective solution for acne management, offering an innovative, patient-friendly approach that leverages botanical extracts with modern drug delivery systems.

Keywords: Acne vulgaris, *Allamanda cathartica*, botanical extract, patch, *Propionibacterium acnes*

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1.0 Introduction

The persistent challenge of acne vulgaris, a chronic multifactorial inflammatory condition, remains the second-highest contributor to the global burden of skin diseases, particularly among teenagers and young adults (1). Conventional treatments, such as topical creams and gels, often contain synthetic ingredients that may cause skin irritation, dryness, and an unpleasant sticky texture and are easily washed off, diminishing their efficacy (2). Inconsistent use further contributes to drug resistance and treatment failure (3). In response to these challenges, GoldClear® Anti-Acne Patch was developed as a natural alternative with potent antimicrobial properties. The patch represents an innovative advancement in healthcare and consumer goods, offering a more effective and convenient acne management solution. In addition to its therapeutic benefits, GoldClear® features a design inspired by the *Allamanda cathartica* flower, aimed at enhancing patient compliance, particularly in adolescent populations. The visually appealing patch serves its primary function as an anti-acne treatment and acts as a discreet and fashionable accessory, potentially improving user adherence by addressing concerns related to the social and psychological impact of acne. By integrating the aesthetic appeal with advanced drug delivery technology, GoldClear® provides a plant-based skincare solution that is both effective and user-friendly, potentially leading to better clinical outcomes through improved patient engagement and consistent usage. This study aims to highlight the significance of GoldClear® in advancing acne treatment and

its potential as a natural and innovative approach to skincare.

2.0 Innovation

GoldClear® an anti-acne patch infused with *A. cathartica* extract (Figure 1A), is enriched with bioactive compounds such as coumarins, phenols, flavonoids, terpenoids, and saponins (4). The extract exhibits high total phenolic (36.22 ± 2.91 mg GAE/g) and flavonoid (12.29 ± 2.25 mg CAE/g) content, which are key contributors to its bioactivity (Figure 1B). GoldClear® was evaluated for its efficacy and safety profile, revealing a median cytotoxic concentration (CC₅₀) of 704.66 ± 7.84 µg/mL on normal human foreskin, BJ fibroblast cell line (ATCC®CRL-2522), indicating low cytotoxicity and safe application on the skin. Additionally, the extract demonstrated a median inhibitory concentration (IC₅₀) of 49.036 µg/mL against *Propionibacterium acnes* (ATCC®-6919), the primary bacterium implicated in acne pathogenesis (Figure 1C). This results in a high selectivity index (SI) of 14.4, signifying that GoldClear® can effectively target *P. acnes* with minimal toxicity to human skin cells.

Figure 2 shows that GoldClear® demonstrated a significantly higher zone of inhibition (28.88 ± 5.52 mm) against *P. acnes* compared to the Tea Tree Oil gel (22.48 ± 3.92 mm). This indicates that GoldClear® possesses superior antibacterial properties, making it a more effective option for targeting acne-causing bacteria. Moreover, the design of GoldClear®, inspired by the golden trumpet flower, not only appeals aesthetically but also serves a functional purpose in enhancing treatment efficacy.

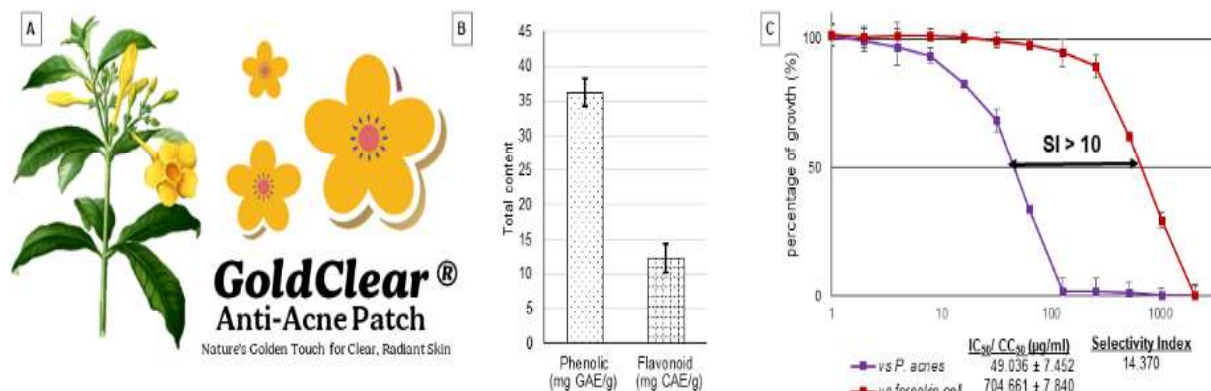


Figure 1: Phytochemical screening and bioactivity of *A. cathartica* extract. (A) Illustration of the plant and the inspired patch design, (B) Quantification of phenolic and flavonoid content, (C) Cytotoxicity and anti-acne activity with a selectivity index (SI) of the plant extract.

As illustrated in Figure 2B, the patch is hypothesised to provide targeted and sustained delivery of the active anti-acne compounds directly to the affected skin layers. This targeted delivery system ensures that the antimicrobial agents penetrate the skin more effectively than conventional topical drug delivery like cream or gel, which are prone to be washed off and may have reduced efficacy over time.

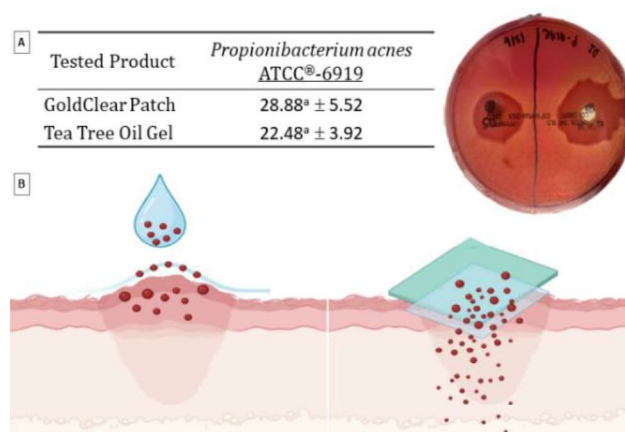


Figure 2: The product efficacy and mechanism of absorption. (A) The disc diffusion study, (B) The comparison of traditional drug delivery with patch mechanism of delivery.

"a" value within a column with the same superscripts are not significantly different from each other at $p > 0.05$.

3.0 Uniqueness

GoldClear® Anti-Acne Patch uniquely combines *Allamanda cathartica* extract, rich in anti-acne compounds, with an advanced drug delivery system. Its hydrocolloid patch ensures targeted and sustained delivery to the skin, outperforming traditional drug delivery like cream or gel. Inspired by the golden trumpet flower, the patch's design enhances user compliance, especially among teenagers. By providing a stylish, effective, and natural acne treatment option, GoldClear® addresses both therapeutic and psychological aspects, offering a safer alternative with reduced risk of resistance and side effects compared to synthetic treatments. This novel approach bridges natural remedies and modern skincare technology.

4.0 Commercialisation Potential

The product appeals to the growing market for plant-based skincare solutions, meeting consumer demand for safe, effective, and aesthetically pleasing treatments. Its unique formulation and design address the limitations of conventional acne treatments,

such as irritation, stickiness, and wash-off issues, making it attractive to teenagers and young adults. The product can be marketed through various channels, including pharmacies, skincare clinics, and online platforms. With increasing interest in natural and sustainable skincare, GoldClear® is well-positioned for global market entry.

5.0 Impact on Quintuple Helix

It advances scientific research in natural skincare, offering a marketable product that meets consumer demand for safe, effective treatments. This aligns with public health initiatives, potentially reducing healthcare burdens. Raising awareness of natural skincare options encourages healthier lifestyle choices and sustainable practices. Additionally, its use of botanical ingredients minimizes environmental impact compared to synthetic chemicals, promoting eco-friendly solutions. GoldClear® fosters collaboration across these sectors, offering societal and environmental benefits through an innovative, holistic approach.

6.0 Conclusion

GoldClear® bridges the gap between natural product efficacy and advanced drug delivery technology, positioning it as a novel and effective solution in the evolving landscape of acne care.

Authorship contribution statement

AZZ: Data analysis, Methodology, Formal analysis, Writing—original draft. **MHH:** Visualization, Methodology, Writing – review & editing. **MM, KAH, AHJ:** Visualization, Draft corrections. **MFM:**

Supervision, Funding acquisition, Writing – review & editing.

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Conflict of Interest

The authors declared that they have no conflicts of interest to disclose.

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Extended Abstract

ChromPATCH: Cutting-Edge *Chromolaena odorata*-Loaded Hybrid Hydrogel Wound Dressing Material for Sustained Healing

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ABSTRACT

Wound management remains a global challenge, particularly for delayed healing and severe infections. Hydrogel dressings have emerged as advanced wound care materials, with increasing interest in incorporating bioactive compounds such as plant extracts. *Chromolaena odorata* (*daun kapal terbang*), often considered an invasive species, possesses antioxidant, antibacterial, anti-inflammatory, and wound-healing properties. This study harnessed its medicinal potential to develop a novel, eco-friendly biopolymer hydrogel wound dressing. The hydrogel, formulated using cross-linked chitosan and polyvinyl alcohol (PVA), demonstrated excellent mechanical strength, high swelling capacity, and antibacterial activity—key characteristics of an ideal wound dressing. The strong swelling behaviour of PVA and chitosan ensures extended wound contact and gradual release of *C. odorata* extract, enabling controlled, sustained bioactive delivery. The hydrogel's release profile follows zero-order kinetics with a diffusion-dominated mechanism, as described by the Higuchi and Korsmeyer-Peppas models, ensuring a moist wound environment and prolonged therapeutic effect. This biocompatible and mechanically resilient hydrogel represents a sustainable, plant-based innovation in wound care, offering an effective alternative for enhanced healing.

Keywords: *Chromolaena odorata*, PVA/chitosan, sustained release, wound healing.

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1.0 Introduction

Wound healing is a complex biological process that remains a significant global healthcare challenge, particularly for chronic or non-healing wounds, which pose substantial risks of infection and morbidity. The selection of appropriate wound dressings is critical to facilitate the healing process, minimise complications, and improve patient outcomes. Traditional dressings often fall short of providing optimal moisture balance, antimicrobial properties, and the necessary support for tissue regeneration. Recent innovations in wound management have led to the emergence of hydrogel dressings, which offer numerous advantages, including moisture retention, gas exchange, and protection against external contaminants.

Combining polyvinyl alcohol (PVA) and chitosan in a hybrid hydrogel offers several advantages over using each polymer alone. While PVA provides excellent mechanical strength and stability, it lacks essential antibacterial properties (1). On the other hand, chitosan enhances antibacterial activity but may not provide the same level of mechanical robustness as PVA (2). By combining these two polymers, the resulting hydrogel benefits from the strengths of both materials, resulting in improved mechanical properties, antibacterial activity, and optimal moisture retention, which are crucial for effective wound healing.

C. odorata, locally known as *daun kapal terbang*, is a perennial shrub often considered an invasive species due to its aggressive growth and ability to outcompete native flora. Despite its negative reputation, this plant has demonstrated significant medicinal potential, with reported antioxidant, antibacterial, anti-inflammatory, hemostatic, and wound-healing properties (3). Prior studies have highlighted the effectiveness of *C. odorata* in enhancing wound healing, making it a promising candidate for incorporation into

wound dressings (4). The transformation of this problematic plant into a valuable resource aligns with sustainable resource management practices and offers pharmacological benefits, showcasing a unique opportunity to harness nature's potential for healing.

Motivated by the dual opportunity of utilising an invasive plant and enhancing wound healing, a novel biopolymer hydrogel wound dressing infused with *C. odorata* extract, ChromPATCH, was developed (5). This hydrogel, cross-linked with chitosan and PVA, demonstrates excellent mechanical strength, high swelling capacity, and significant antibacterial activity key characteristics of an ideal wound dressing.

2.0 Innovation

The uniqueness of ChromPATCH lies in its innovative use of *C. odorata*, a commonly problematic invasive plant species by transforming it into a valuable resource for wound care. This approach not only addresses environmental concerns by managing invasive plant species but also harnesses their medicinal potential for therapeutic use. Integrating PVA, chitosan, and *C. odorata* extract into a single hydrogel matrix offers a multi-functional wound dressing with enhanced mechanical properties, swelling behaviour, good hydrophilicity, adequate antimicrobial activity, and sustained bioactive release.

To support the formulation's efficacy, various tests were conducted, including cytotoxicity assessments that revealed the hydrogel were non-toxic towards Human keratinocytes (HaCaT) cells over seven days, indicating its biocompatibility (Figure 1(a)). The wound scratch assay also demonstrates that the hydrogel significantly enhances cell proliferation within 24 hours, achieving 100% wound closure *in vitro* (Figure 1(b)). These findings affirm the hydrogel's suitability as an advanced wound dressing,

providing a comprehensive solution that effectively addresses multiple wound care challenges.

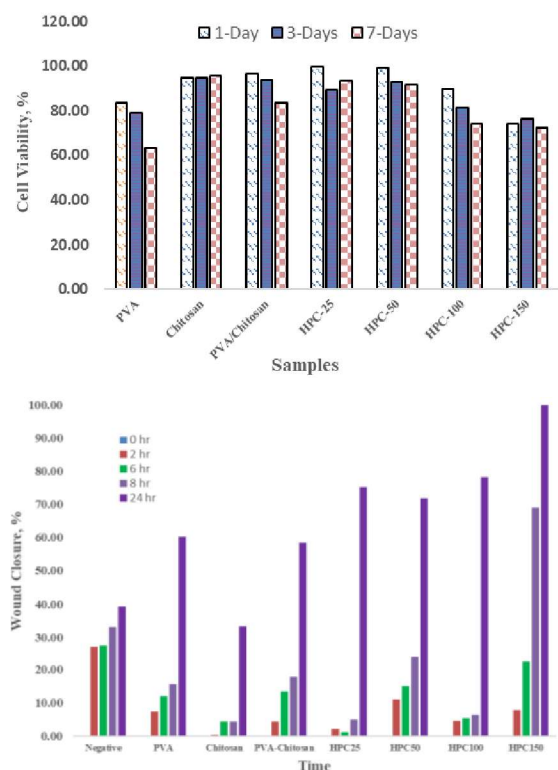


Figure 1: *In vitro* potency of ChromPATCH. (a) HACAT cell viability for Day 1, Day 2 and Day 7; (b) Wound closure rate (%) over time (0, 2, 6, 8, and 24 hours) based on the scratch assay of HACAT cells.

Furthermore, compared to traditional wound dressings, ChromPATCH provides a controlled and sustained release of therapeutic agents to support faster wound healing. This allows the hydrogel to release active agents gradually, maintaining prolonged therapeutic effects while preventing bacterial colonisation. The release profile of the hydrogel aligns with zero-order. The Higuchi and Korsmeyer-Peppas model suggest a diffusion-dominated mechanism that facilitates consistent bioactive delivery over time (Figure 2).

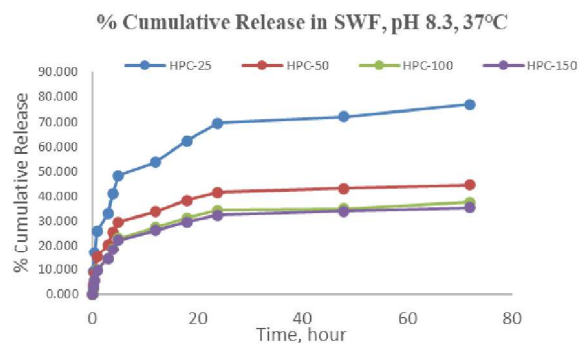


Figure 2: *In Vitro* Cumulative release of *C. odorata* extract in SWF, pH 8.3, 37°C.

3.0 Uniqueness

The combination of PVA and chitosan forms a highly absorbent, mechanically stable hydrogel with desirable mechanical and swelling properties. These characteristics ensure prolonged contact with the wound, enabling sustained release of *C. odorata* extracts. PVA provides the necessary structural integrity, while chitosan contributes bioactive properties that reduce microbial contamination and inflammation. Incorporating *C. odorata* leverages its bioactivity, providing an eco-friendly and functional enhancement to the hydrogel, aligning with Quality-by-Design (QbD) principles.

ChromPATCH distinguishes itself through its innovative formulation strategy, transforming an invasive plant into a valuable healthcare resource. This unique combination positions ChromPATCH as a cutting-edge solution in wound management, with significant implications for environmental sustainability and patient care.

4.0 Commercialisation Potential

The commercialisation of ChromPATCH will significantly be supported by its adherence to regulatory standards and the adoption of the Quality by Design (QbD) approach during the formulation stages. Comprehensive testing protocols were conducted to validate ChromPATCH's performance (Table 1). Mechanical testing was performed

according to American Society for Testing and Materials protocols to assess the hydrogel's tensile strength and elasticity. Cytotoxicity was evaluated using the MTT assay per ISO 10993 to confirm that ChromPATCH is non-toxic to HaCaT cells over 7 days. Antimicrobial activity was assessed against *Streptococcus aureus* following Clinical and Laboratory Standards Institute guidelines demonstrating effective infection management.

In addition, the economic potential of ChromPATCH could be regarded as substantial as it addresses the increasing demand for advanced wound care solutions, particularly in aging populations and patients with chronic wounds. By transforming the problematic *C. odorata* plant into a valuable resource, ChromPATCH offers a sustainable and eco-friendly solution and minimises raw material costs, hence positioning ChromPATCH as a cost-effective solution in the healthcare market. Future efforts will focus on clinical trials to further substantiate its efficacy, expand market access, and foster partnerships with healthcare providers, industries, and distributors.

Table 1: Key Performance Attributes of ChromPATCH

Attributes	Description
Mechanical Strength	Adequate tensile strength and flexibility.
Swelling Capacity	Maintains moisture, ensuring prolonged wound contact, proven hydrophilicity.
Antibacterial Activity	Effective against <i>Streptococcus aureus</i>
Cytotoxicity	Non-toxic to HaCaT cells over 7 days
Healing Efficacy	Achieves 100% wound closure within 24 hours
Release Profile	It follows zero-order and Higuchi kinetics, a diffusion-dominated mechanism described by the Korsmeyers-Peppas model.

5.0 Impact on Quintuple Helix

The development of ChromPATCH offers broad-reaching impacts across the Quintuple

Helix. From an environmental perspective, it transforms an invasive plant species into a valuable resource, supporting sustainability goals. For society, it offers a cost-effective wound care solution that addresses global healthcare needs, particularly in regions with high rates of chronic or infected wounds. In the academic realm, it advances research into biopolymer hydrogels and plant-based medicine, encouraging further exploration into sustainable wound care technologies. From an industry standpoint, ChromPATCH offers a scalable, innovative product that can capture significant market share, while government support for environmentally conscious solutions enhances its potential for policy-driven growth.

6.0 Conclusion

ChromPATCH is an eco-friendly, biocompatible hydrogel that integrates PVA, chitosan, and *C. odorata* extract for enhanced wound healing. It enables sustained drug release, achieves 100% wound closure in 24 hours, and exhibits antibacterial activity. By repurposing an invasive plant, ChromPATCH offers a sustainable, effective, and safe wound care solution.

Authorship contribution statement

NAM: Data analysis, Methodology, Formal analysis, Writing—original draft. **FMT:** Writing – review & editing. **NBAK:** Supervision Resources, Funding acquisition, Draft corrections. **WNHI:** Writing – review & editing. **SNF:** Writing – review & editing. **EY** – Collaboration, review & editing.

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Conflict of Interest

The authors declared that they have no conflicts of interest to disclose.

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Extended Abstract

Arduino-Enhanced Smart Hat for Blind Navigation

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ABSTRACT

Arduino-Enhanced Smart Hat for Blind Navigation is an innovative wearable technology designed to improve mobility and safety for the visually impaired. Utilising an Arduino Uno, the system integrates ultrasonic sensors, a buzzer, and vibration motors, all embedded seamlessly into a comfortable hat. The ultrasonic sensors continuously scan the environment for obstacles, calculating distance with precision. When an obstacle is detected within a predefined range, the system triggers tactile feedback through a gentle vibration and an optional audible alert via a buzzer. This dual-sensory warning system allows users to navigate their surroundings with enhanced awareness, promoting greater independence and confidence in unfamiliar environments. The Guardian Hat is a practical, cost-effective solution that provides real-time, hands-free obstacle detection. By offering both vibration and sound alerts, it caters to diverse user needs, making it adaptable to varying levels of sensory perception. The simplicity, affordability, and user-centric design of the system make it a highly effective tool in improving the quality of life for the visually impaired, fostering autonomy and ensuring safety in daily navigation.

Keywords: Arduino, blind people, obstacle detection, ultrasonic sensor

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1.0 Introduction

As society becomes increasingly aware of the challenges faced by visually impaired individuals, the demand for more effective navigation aids has grown. Traditional aids often rely solely on physical contact with obstacles, restricting users' awareness of their surroundings and increasing the risk of accidents. This limitation necessitates the development of a more advanced solution that offers comprehensive environmental awareness, enabling users to navigate confidently in various settings. The Arduino-Enhanced Smart Hat for Blind Navigation aims to revolutionise mobility and safety for visually impaired individuals through innovative wearable technology. Its primary purpose is to provide real-time obstacle detection, enabling users to navigate their environments with enhanced awareness and confidence. By integrating ultrasonic sensors, vibration motors, and auditory alerts, this innovation addresses significant gaps in current mobility aids, such as traditional walking sticks, which often lack comprehensive environmental awareness and guidance. The Guardian Hat offers a proactive approach to navigation, significantly reducing the risk of accidents and allowing users to move independently in various settings. This is crucial for empowering visually impaired individuals to engage more fully with their communities and everyday environments. Unlike conventional mobility aids, the Guardian Hat is designed with user feedback and needs at its core. Its dual-sensory alert system via vibration and alarm sound caters to diverse sensory perceptions, making it adaptable for a wider range of users. By providing clearer directional feedback and 360-degree obstacle detection, the Guardian Hat fosters a sense of autonomy and self-assurance among users. The scope of the Arduino-Enhanced Smart Hat spans several key areas. The project incorporates customised and affordable

technology, including ultrasonic sensors and Arduino programming, to create a reliable yet user-friendly navigation aid. The ability to customise sensor settings enhances its adaptability for different environments. The Guardian Hat aligns with healthcare initiatives to improve assistive devices for individuals with disabilities. By reducing accidents and improving mobility, it can potentially lower healthcare costs associated with injuries among visually impaired individuals. As a consumer product, the Guardian Hat addresses a growing market for assistive technologies. Its affordability and practicality make it an appealing option for individuals, families, and organisations seeking effective mobility solutions. The Arduino-Enhanced Smart Hat for Blind Navigation is an innovative tool for enhancing the mobility and safety of visually impaired individuals and serves as a model for future developments in assistive technology. Its comprehensive approach has the potential to impact technology, healthcare, and consumer goods positively, making it a significant contribution to improving the quality of life for those with visual impairments.

2.0 Innovation

The design process for the Obstacle Detection Aid System began with identifying key components essential for effective obstacle detection. The Arduino UNO R3 microcontroller is central to this system, chosen for its versatility and ease of programming. Complementing the microcontroller are four ultrasonic sensors, four vibrator motors, and a buzzer. Each was selected for its ability to facilitate real-time feedback and alert users to potential hazards. The initial phase involved designing and assembling the device components, ensuring seamless integration of hardware. The ultrasonic sensor serves as the cornerstone of the system, tasked with detecting obstacles

within a range of 120 cm. The system's flow focused on programming the device using the Arduino UNO application, as shown in Figure 1. The code is structured to interpret data from the ultrasonic sensor accurately, enabling it to measure the time taken for sound waves to travel to an obstacle and back. The ultrasonic sensor operates by emitting high-frequency sound waves; when these waves hit an object, they bounce back to the sensor, allowing it to calculate the distance based on the elapsed time. For an effective obstacle detection range of 120 cm, the sensor measures the total distance covered by the sound waves 240 cm, which considers 120 cm to the object and 120 cm back to a receiver. When an obstacle is detected at this distance, the sensor outputs a high signal for 700 microseconds, triggering the corresponding vibration motors and buzzer to alert the user, as shown in Table 1. The integration of these components culminates in a user-friendly device that offers real-time feedback, significantly enhancing the user's navigation experience. To achieve this, the sensor must be carefully configured and calibrated to ensure accuracy in detecting objects within its field of vision.

The design incorporates the following pin allocation for the Arduino UNO:

Digital Pins 2-9: Dedicated to the ultrasonic sensors (trigger and echo pins).

Digital Pins 10-13: Connected to the vibration motors that provide tactile feedback.

Digital Pin A0: Used for the buzzer, which delivers audible alerts.

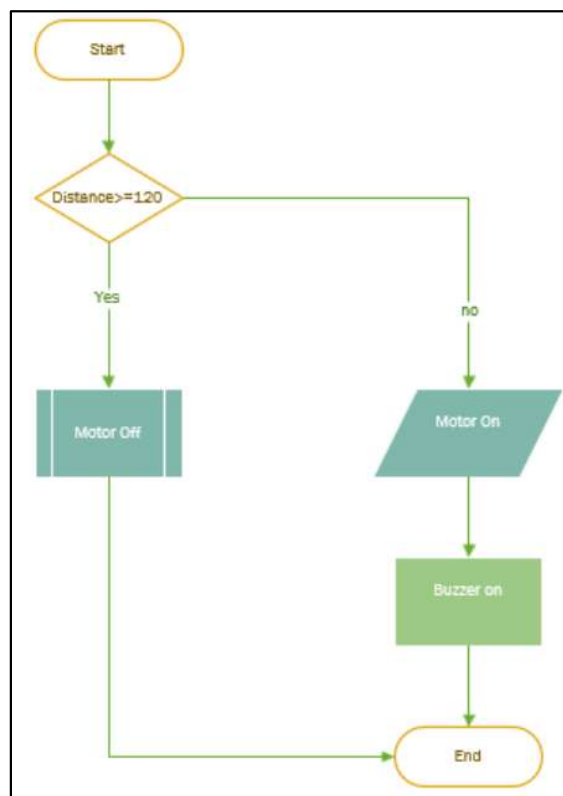


Figure 1: Flowchart of the Arduino-Enhanced Smart Hat for Blind Navigation system.

Table 1: The observations recorded during the temperature value testing.

Condition	Results
Obstacle in front of the left body	The ultrasonic sensor and vibrating motor on the front left side are activated. The buzzer is also triggered.
Obstacle in front of the right body	The ultrasonic sensor and vibrating motor on the front right side are activated. The buzzer is also triggered.
Obstacle behind the left body	The ultrasonic sensor and vibrating motor on the rear left side are activated. The buzzer is also triggered.
Obstacle behind the right body	The ultrasonic sensor and vibrating motor on the rear right side are activated. The buzzer is also triggered.

3.0 Uniqueness

The Arduino-Enhanced Smart Hat for Blind Navigation introduces a novel and highly effective solution for obstacle detection, offering unique advantages over existing products in the market. Visually impaired or blind individuals commonly rely on walking sticks as aids for navigation and mobility. Various new technologies, including smart sticks, have recently been developed and researched to enhance these traditional aids. However, these sticks come with notable limitations; for instance, they cannot provide a 360-degree view of the environment or detect obstacles at head level. Additionally, users must hold the stick, which restricts their ability to use both hands for other tasks. These papers highlight the need for innovative solutions that can address these challenges and improve mobility for visually impaired individuals, Nowshin *et al.* (2017) (1), Gbenga *et al.* (2017) (2), Kavitha and Akshatha (2023) (3), Shah *et al.* (2021) (4). Unlike traditional devices, this innovation covers a full 360-degree range, enabled by four strategically placed ultrasonic sensors that monitor the front, back, left, and right surroundings. One research paper explored the use of three ultrasonic sensors embedded in a hat for navigation; however, it only provided a buzzer as the output, Badoni *et al.* (2024) (5). This limitation resulted in a lack of clear directional guidance for visually impaired individuals, making it challenging to determine the safest path away from obstacles.

In contrast, this project enhances user guidance by incorporating vibration motors that activate based on the detected obstacles, indicating the safest direction for the user to navigate. Each sensor is paired with its corresponding vibration motor, providing direct feedback. This feature helps users intuitively identify obstacles and determine the safest path forward, offering a more comprehensive awareness of their

environment. In addition to its full-range detection, the system's flexibility is a key strength. Powered by Arduino, the distance sensitivity of the obstacle detection system can be reprogrammed to meet specific user needs. For instance, in crowded spaces, the trigger distance can be adjusted to 150 cm, offering extra protection and customisation for various scenarios. This reprogrammable feature provides users with an adaptable, hands-free solution that enhances both mobility and safety. Overall, the simplicity, affordability, and user-centric design of the Guardian Hat, combined with its unique 360-degree obstacle detection and customisable settings, make it an original and innovative tool for improving the quality of life for visually impaired individuals. It empowers users with greater independence and confidence, ensuring safety in diverse environments.

4.0 Commercialisation Potential

To successfully commercialise the Guardian Hat, several key factors must be addressed to ensure its effective and sustainable market entry. One crucial aspect is developing and testing prototypes in diverse environments to ensure the Guardian Hat performs reliably in various settings, such as crowded spaces, fast-paced areas, and on different terrains like stairs and ramps. Additionally, it is essential to ensure the product complies with all safety standards for wearables and electronics, particularly because it will be used by vulnerable individuals. Incorporating feedback from actual users, such as visually impaired individuals, is vital for refining the product to meet real-world needs. Market research should also assess the demand for assistive devices among visually impaired individuals and caregivers and identify target markets, such as visually impaired communities, healthcare institutions, and disability organisations. Pricing the product competitively is another key consideration,

particularly for users with limited financial resources. Offering different basic and advanced versions could cater to a wider range of budgets, increasing accessibility. Addressing these factors can establish a strong foundation for successfully commercialising the Guardian Hat, making it a viable and accessible product for visually impaired individuals.

5.0 Impact on Quintuple Helix

The Guardian Hat significantly enhances the quality of life for visually impaired individuals by improving their mobility, safety, and independence through hands-free, proactive obstacle detection. This reduces the risk of accidents, enabling users to navigate more confidently and fostering greater social inclusion while reducing dependence on caregivers. In academia, the Guardian Hat contributes to research in assistive technologies, wearable devices, and human-computer interaction, serving as a platform for innovations in mobility aids, sensor systems, and accessibility design. For governments, the Guardian Hat aligns with initiatives promoting accessibility and inclusivity for individuals with disabilities, supporting policies focused on universal design and public space access. It also holds the potential to reduce healthcare costs by preventing accidents and injuries. Environmentally, the Guardian Hat reduces reliance on traditional, less sustainable mobility aids, encouraging the development of eco-friendly assistive devices. Its compact and energy-efficient design aligns with efforts to minimise waste and energy consumption, promoting sustainability in wearable technology.

6.0 Conclusion

The Arduino-Enhanced Smart Hat for Blind Navigation represents a significant step

forward in assistive technology for the visually impaired, offering a practical, cost-effective, and user-friendly solution for real-time obstacle detection. The system provides dual-sensory feedback that enhances mobility and safety in unfamiliar environments by integrating ultrasonic sensors, vibration motors, and a buzzer. The simplicity of the design and adaptability to diverse sensory needs make the Guardian Hat an innovative and accessible tool that fosters greater independence, confidence, and autonomy for visually impaired users. Its affordability and hands-free functionality ensure widespread usability, improving the quality of life for those with visual impairments. This project underscores the potential of wearable technologies in addressing real-world challenges, providing a scalable model for future developments in assistive devices.

Authorship contribution statement

FAS: Data analysis, Methodology, Writing—original draft. **SACK:** Supervision, Funding acquisition, Formal analysis, Writing—review & editing. **SH, RA, NA, & SM:** Draft corrections – review & editing.

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Conflict of Interest

The authors declared that they have no conflicts of interest to disclose.

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Extended Abstract

I-Potty Pro: Enhancing Toilet Independence Through Interactive Support for Preschool Children

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ABSTRACT

Teaching self-care independence, specifically toilet training, is crucial for preparing children for school readiness. However, parents and teachers often lack effective tools to guide children through this essential developmental milestone. I-Potty Pro offers an innovative solution with an occupational therapy-based approach to toilet training. What makes it unique is the integration of evidence-based strategies, techniques, and approaches not found in traditional tools. I-Potty Pro directly addresses delayed toilet independence, which can negatively affect a child's confidence and school readiness. It serves as an educational tool for parents, caregivers, and teachers, promoting self-care skills in preschool children through structured, interactive guidance. By leveraging technology, I-Potty Pro fosters independence while advancing early childhood development practices. A cognitive interview approach was conducted with three parents and two teachers to assess the app's usability. Results revealed that I-Potty Pro is "time-efficient" and "accessible ubiquitously by both parents and teachers". The app's scalability makes it suitable for widespread use in preschools, day care and homes. Further study will be conducted to evaluate the effectiveness of the I-Potty Pro application, providing empirical evidence to support its commercialization.

Keywords: Independence, preschool children, digitalized, self-care, school readiness

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1.0 Introduction

Over the past century, recommended toilet training methods in North America have alternated between two dominant approaches: rigid, adult-directed methods and more child-focused approaches. In 1962, Brazelton introduced the "child readiness" approach, which emphasizes gradual, child-centered training that respects the child's developmental pace (1).

Common challenges in toilet training include delayed initiation and inconsistent practices (2). Early training may be preferred in some cultures, while others may prioritize waiting until the child shows signs of readiness. These variations are shaped by parental expectations and societal pressures (2). The I-Potty Pro is designed to address these challenges, offering an innovative, interactive approach to promote independence in preschool children. Children who achieve self-care independence often demonstrate strong skills when parents provide appropriate opportunities for modelling and practice (3). These opportunities help children develop age-appropriate self-care abilities and improve their social skills during preschool, which are crucial for school readiness (2).

The I-Potty Pro simplifies toilet training using engaging technology that motivates children through visual cues and personalized feedback. It fosters positive habits in a supportive environment, reducing the frustration often seen with traditional methods. The I-Potty Pro combines consumer technology and healthcare support, enhancing children's independence and benefiting their emotional and cognitive growth through a connected app that provides parental guidance.

2.0 Innovation

This app consists of six tabs in Malay version as shown in Figure 1. Each tab is designed to assist teachers and parents in guiding children through toilet training, providing accessible information anytime and anywhere. All the content is organized and sourced from evidence-based studies. All critical aspects, such as the suitable age to start toilet training, tools, and materials needed, are included in the introduction. This app is easy to understand; however, it requires parents to have an email and internet connection to access it. The content is developed in Malay, as Bahasa Melayu is the national language of Malaysia. The intellectual property rights for I-Potty Pro, including copyright, are currently under application to secure its unique concept and technology (IP/PT/00252).



Figure 1: Interface of I-Potty Pro app.

3.0 Uniqueness

I-Potty Pro is innovative in its integration of occupational therapy principles with a digital platform, providing evidence-based, structured guidance for toilet training. Unlike traditional tools, I-Potty Pro offers an interactive, user-friendly interface that allows parents and teachers to access resources ubiquitously. The app's comprehensive approach covers all aspects of toilet training, from readiness skills to strategies and tips, ensuring that users have a complete toolkit at their fingertips. The techniques suggested include three combination techniques (4), the Child-Oriented Toilet Training Method, and Foxx and Azrin's Method of Toilet Training in Less Than One Day (1). Previous studies have validated all of these techniques. This unique combination of professional insight and digital accessibility sets I-Potty Pro apart from existing solutions, often requiring parents and teachers to search for information online or rely on paper materials. At the same time, we can support environmental sustainability by going paperless.

4.0 Commercialisation Potential

Grounded in established research on early childhood development, the app holds strong potential for collaboration with educational institutions and healthcare providers, reinforcing both its academic foundation and market viability. Its scalable design supports broad adoption across homes, preschools, and daycare centres. The app's key advantage lies in its evidence-based content and customizable features for children with special needs, including Autism. Potential business models include subscription plans, premium content, and institutional partnerships, supporting sustainable growth.

5.0 Impact on Quintuple Helix

I-Potty Pro promotes child independence and reduces caregiver stress, improving family well-being and school readiness. It contributes to academic research and training in early childhood development. For government, it aligns with Malaysia's Education 2030 Agenda and SDG 4. The app also drives innovation in EdTech and healthcare sectors, while supporting environmental sustainability through a fully digital, paperless approach.

6.0 Conclusion

I-Potty Pro offers an innovative, evidence-based solution to improve toilet training in early childhood through accessible digital technology. Integrating occupational therapy principles with interactive features supports child development, caregiver guidance, and inclusive education. Its scalability and relevance across home, school, and healthcare settings make it a valuable tool for widespread adoption and long-term impact.

Authorship contribution statement

NAA: Data analysis, Methodology, Formal analysis, Writing—original draft, Draft corrections.; **NAA, NKH:** Visualization, Resources, Development apps, **MK, FWY, KC:** Supervision, Funding acquisition, Writing – review & editing.

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Conflict of Interest

The authors declared that they have no conflicts of interest to disclose.

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Extended Abstract

AI-Driven Pneumonia Diagnosis from Chest X-Rays

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ABSTRACT

Pneumonia remains a significant global health issue, especially in areas with limited diagnostic resources. Traditional methods for diagnosing pneumonia from chest X-rays are slow and require expert radiologists. We developed an AI-powered pneumonia detection tool using convolutional neural networks (CNNs) with VGG16 and Inception models. These models were trained on chest X-ray datasets and achieved high accuracy in classifying pneumonia. Our app, built with Flask, allows healthcare professionals to upload X-rays and get real-time predictions with confidence scores. The system supports continuous learning through user feedback, improving its performance. This tool can potentially revolutionise pneumonia diagnosis, especially in low-resource settings.

Keywords: Chest X-rays, convolutional neural networks, deep learning, pneumonia diagnosis

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1.0 Introduction

Pneumonia remains a leading cause of mortality, especially in low-resource settings where timely diagnosis is challenging due to limited access to radiologists. Early detection is crucial for effective treatment and improving patient outcomes (1). Recent advancements in artificial intelligence (AI) and deep learning have revolutionised medical image recognition, enabling real-time automated diagnostic solutions (2), including detecting pneumonia from chest X-rays, offering faster and more accurate results while reducing the burden on healthcare professionals.

2.0 Innovation

The system uses pre-trained VGG16 and Inception models for image classification, which were fine-tuned for pneumonia detection. The AI model processes chest X-rays and gives clinicians confidence scores for pneumonia detection. The app interface allows real-time predictions, continuous feedback, and performance tracking. This innovative design ensures the system remains accurate and adaptable to real-world usage. Figure 1 illustrates the methodology used, while Figure 2 shows the interface of the pneumonia detection app.

3.0 Uniqueness

Our app integrates multiple models, dynamically switching between them based on feedback. The system learns continuously, enhancing accuracy without manual updates. Real-time performance tracking, including accuracy and precision, helps clinicians make informed decisions. These features make it a powerful tool for diagnosing pneumonia in various healthcare settings.

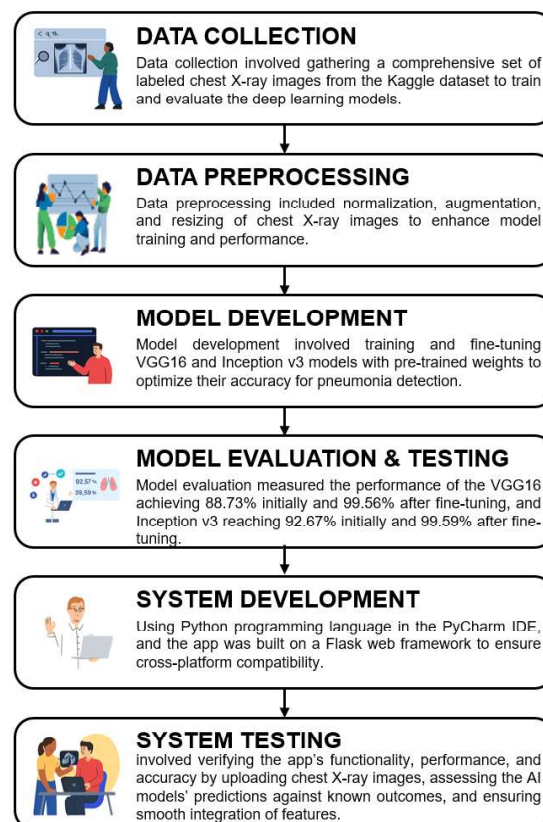


Figure 1: Overview of the six-step process for developing a deep learning-based pneumonia detection system using chest X-ray images.

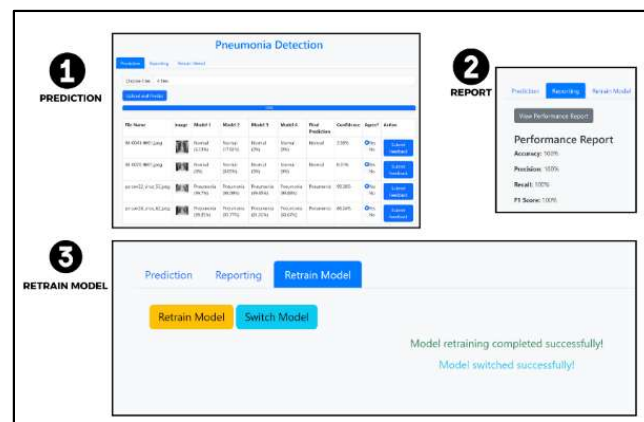


Figure 2: Interface of AI-Driven Pneumonia Diagnosis from Chest X-Rays.

4.0 Commercialisation Potential

There is a strong demand for AI diagnostic tools in healthcare. Our system is scalable and designed for ease of integration into

existing workflows, making it well-suited for hospitals, clinics, and telemedicine platforms. Its potential application in resource-limited settings and compatibility with healthcare systems globally, enhances its viability for commercialisation.

5.0 Impact on Quintuple Helix

The app's accessibility improves early pneumonia detection, particularly in underserved areas. It supports research and innovation in AI healthcare and contributes to sustainable practices by reducing reliance on physical diagnostics infrastructure.

6.0 Conclusion

Our AI-driven pneumonia diagnosis app offers an efficient, scalable, and continuously improving solution for healthcare professionals. Its adaptability and potential for commercialisation can transform pneumonia diagnosis, particularly in resource-limited environments.

Authorship contribution statement

SS: Data analysis, Methodology, Formal analysis, Writing–original draft. **MK:** Writing – review & editing, Draft corrections, Supervision, Funding acquisition.

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Conflict of Interest

The authors declared that they have no conflicts of interest to disclose.

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Extended Abstract

Fisetin nanosuspension: Potential inhibitor of monoamine oxidase in A β ₍₂₅₋₃₅₎ induced mice

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ABSTRACT

The key pathological hallmarks of Alzheimer's disease (AD) include extracellular β -amyloid (A β) plaques and intracellular neurofibrillary tangles. Fisetin, a neuroprotective antioxidant, is widely consumed through fruits and vegetables but has low bioavailability, poor solubility and high metabolism, limiting its therapeutic potential. This study aimed to develop a fisetin nanosuspension to improve its bioavailability and neuroprotective effects in A β ₍₂₅₋₃₅₎ induced dementia mice. The nanosuspension was prepared by nanoprecipitation method and characterised. For *in vivo* study, mice were treated with 10 and 20 mg/kg of fisetin or 10 mg/kg fisetin nanosuspension daily for 21 days, followed by intracerebroventricular A β ₍₂₅₋₃₅₎ injection (ICV) on day 15. Memory and learning tests were conducted on day 20, and biochemical analyses were performed on brain tissues. The nanosuspension had an average particle size of 225.4 ± 2.95 nm, polydispersity index (PDI) of 0.19 and zeta potential of -19.13 ± 1.17 mV. *In vivo* results showed significant memory and learning improvement ($P < 0.01$) and reduced monoamine oxidase-A (MAO-A) levels ($P < 0.01$), suggesting neuroprotection against A β peptide-induced amnesia. The fisetin nanosuspension effectively enhanced oral bioavailability and inhibited MAO-A activity, presenting a promising approach for future AD drug development.

Keywords: Alzheimer's disease, fisetin, nanosuspension, monoamine oxidase

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1.0 Introduction

The aggregation of A β protein and hyperphosphorylated tau protein are the neuropathological hallmarks of Alzheimer's disease (AD). These pathological changes escalate the production of monoamine oxidase (MAO) enzymes, among many others, with imbalanced neurotransmitters (dopamine, serotonin) in the brain. Fisetin (3, 7, 3',4'-tetrahydroxyflavone) is a plant flavanol commonly found in various fruits and vegetables, has demonstrated antioxidant and neuroprotective properties (1). However, its therapeutic potential is limited by characteristics such as low oral bioavailability, poor aqueous solubility, and extensive intestinal and hepatic metabolisms (2). To address these limitations, nano-formulation has been introduced as an alternative delivery method to enhance fisetin's solubility and stability

2.0 Innovation

Fisetin nanosuspension was formulated via the nanoprecipitation method. The organic phase consisted of a 1:2 ratio of fisetin to PDLG 5002A, dissolved in a 1:4 mixture of DMSO and acetone. The organic phase was then injected into 10 mL of aqueous phase containing a chosen stabilizer (PVA) during ultrasonication. After evaporation, the mixture was centrifuged to obtain the supernatant. The fisetin nanosuspension was assessed for its optimized properties, such as particle size, zeta potential and PDI. As a result, the optimized nanosuspension significantly reduced the level of MAO-A in an *in vivo* setting.

3.0 Uniqueness

PDLG [poly(d,l-lactic-co-glycolic acid)] 5002A, a specific type of PLGA [poly(lactic-co-glycolic acid)], was used in the preparation of fisetin nanosuspension. It is

biodegradable, biocompatible and exhibits low toxicity level (3).

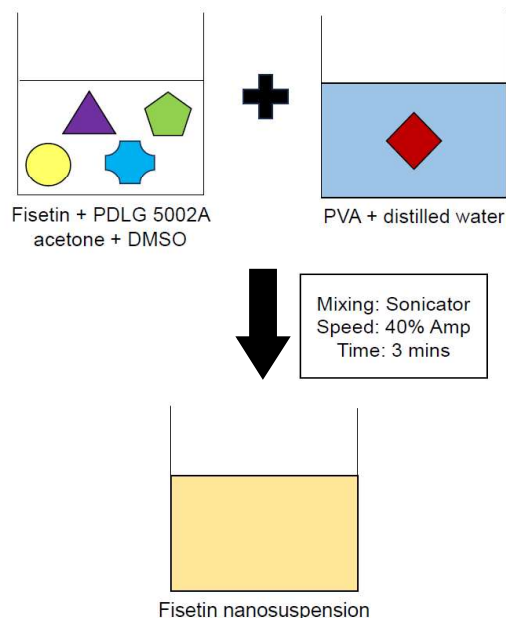


Figure 1: Preparation of fisetin nanosuspension using the nanoprecipitation method.

4.0 Commercialisation Potential

Compared to commercially available drugs, fisetin, as a natural bioactive compound, has the potential to minimize adverse effects. Furthermore, the prepared fisetin nanosuspension enhanced its solubility and stability. This is supported by evidence showing that the nanosuspension significantly reduced ($P < 0.01$) the concentration of monoamine oxidase-A (MAO-A) enzymes and increased ($P < 0.01$) memory and learning performances in A β peptide-induced mice.

5.0 Impact on Quintuple Helix

Fisetin is derived from natural products that align with environmental sustainability goals. Its use in medicine can encourage the development of eco-friendly drug formulation and production practices. Fisetin's integration into the Quintuple Helix model can enhance interdisciplinary

collaboration, promote health and sustainability, and drive innovation in various sectors.

6.0 Conclusion

Fisetin nanosuspension enhanced bioavailability with its optimized properties and exhibited effective neuroprotection through the inhibition of MAO enzymes.

Authorship contribution statement

SZIZ: Writing – original draft, Writing - review & editing, Conceptualization, Methodology, Formal analysis. **HSJC:** Writing – review & editing, Supervision, Data curation. **MHH:** Supervision. **SAJ:** Supervision. **AKJ:** Methodology, Supervision.

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Conflict of Interest

All authors declared that there is no conflict of interest.

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Extended Abstract

SmartMY – An Easy-access Medication Price Checker Mobile Application Prototype

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ABSTRACT

The rising cost of generic and brand-name medications have raised concerns about affordability and accessibility. In Malaysia's private healthcare system, individuals may face high out-of-pocket expenses, necessitating a reliable pricing guide. However, no existing mobile application provides convenient access to medication prices. SmartMY was developed as a user-friendly mobile app to enhance public access to recommended retail medication prices. Built on the AppSheet platform, it integrates retail price data from the Pharmaceutical Services Programme, Ministry of Health (MOH) Malaysia. The application interface was designed to facilitate a pricing search capability using the generic name, brand name, or medication registration number. The information provided includes the retail price per unit and per pack of the medication. The pricing within the application serves as a guide for retail prices. The users may also provide feedback for the continuous improvement of the application. An intuitive mobile application for a medication retail price guide was designed and developed. This application serves as a useful tool for the public to readily access and compare medication prices, promoting transparency and informed decision-making when purchasing medications. With regular updates and user feedback, the application aims to provide accurate and up-to-date information for users seeking affordable healthcare options. In the future, the application seeks to augment its functionality by incorporating a price comparison feature that enables users to compare medication prices from different community pharmacies.

Keywords: mobile application, medication, price

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1.0 Introduction

The cost of medications, which constitutes a significant portion of health expenditure, has increased throughout the years. In developing countries, particularly those with a prominent presence in the private health sector, most of the public purchases medications through out-of-pocket payments (1). Both generic and originator medications' prices were shown to have substantial price markups (1,2). This raises issues about the affordability and accessibility of medicines among the public. Low medication affordability may hinder public access to high-quality pharmaceutical care.

In the dual healthcare system in Malaysia, some individuals may seek medications from private health sectors such as community pharmacies and private hospitals. With various options to acquire their medications from the private healthcare sector, a medication pricing guide would be a valuable tool to help them make informed purchases.

To date, no mobile application in Malaysia provides convenient access to medication pricing. Thus, this study aims to develop a mobile application prototype (*Semak Harga Ubat*, SmartMY) for a medication price checker to assist the public in their medication purchasing decisions.

2.0 Innovation

SmartMY was developed through the AppSheet platform. With the first click of the mobile application, the user will be brought to the "About" page, which introduces the application and provides brief information on its terms. The application integrated medications' retail price data from the Pharmaceutical Services Programme, Ministry of Health (MOH) Malaysia into the platform (3). A search functionality was built in which the users can find the price using a medication's generic name, brand name, or registration number (Figure 1). The mobile

application provides essential pricing information, including the retail price per unit and per pack of the medications. Additionally, a feedback feature was incorporated to allow users to offer suggestions for continuous improvement, enhancing the application's functionality and ensuring it remains updated with user needs.

SmartMY prioritises data security and privacy by ensuring that no personal or sensitive health data is collected from users. The app functions solely as a price-checking tool, utilising publicly available pricing data from the MOH Malaysia. Future versions of the application may incorporate encryption protocols to safeguard data and implement secure Application Programming Interface (API) access to facilitate protected interactions with external databases, should additional functionalities be introduced.

3.0 Uniqueness

SmartMY is the first mobile application in Malaysia designed to cater to the need for a medication price checker. With its user-friendly and intuitive interface, SmartMY enables the public to quickly check retail medication prices as recommended by the product registration holders. Moreover, the feedback feature allows for continuous application enhancement, addressing the users' needs. This innovative application empowers consumers by providing transparency in medication pricing, ultimately helping them make informed decisions about their medication purchases. By incorporating user feedback, SmartMY can adapt and evolve to better serve the needs of its users, ensuring a seamless experience.

4.0 Commercialisation Potential

SmartMY addresses the growing need for medication price transparency and comparability. Malaysia possesses a substantial consumer market of community

pharmacies and private hospitals where out-of-pocket payment is required (4).

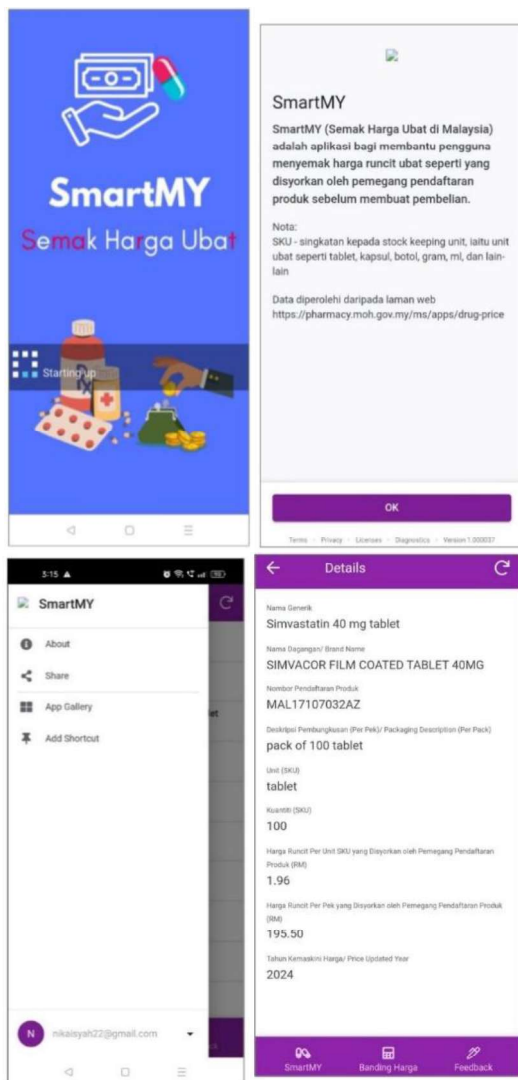


Figure 1: Interface in the SmartMY mobile application.

They will be the target users for this mobile application. Additionally, SmartMY has a huge potential for functionality enhancement, such as a price comparison feature among different community pharmacies and private hospitals. This facilitates partnerships with the private healthcare sector, including insurance companies. Moreover, a premium subscription can provide additional features such as medication refill reminders.

5.0 Impact on Quintuple Helix

SmartMY enhances accessibility to affordable healthcare by empowering the public with medication price information. This also ensures equitable access to high-quality healthcare. This innovation leverages data from the Ministry of Health, Malaysia, to bolster the government's quality use of medicines initiative, in accordance with Malaysia's National Medicines Policy. Academically, this innovation may provide valuable insights into consumers' medication purchasing trends and medication affordability.

Additionally, this mobile application promotes healthy price competition within the private healthcare sector. Community pharmacies and private hospitals may modify their pricing strategies to align with consumer expectations and market competitiveness, ultimately benefiting patients as the primary stakeholders in healthcare. In the long term, hospitals and pharmacies may gain from heightened consumer engagement, as price transparency can foster trust between healthcare providers and patients. Pharmacies and hospitals can enhance patient satisfaction while maintaining business sustainability in a more transparent marketplace.

6.0 Conclusion

SmartMY is a valuable tool for the public to conveniently access the recommended retail medication prices, promoting informed decision-making when purchasing medications. The availability of this mobile application has the potential to influence prescribing patterns. Physicians may increasingly consider patients' financial capacity when recommending treatment options, particularly for individuals from lower-income groups. This enhanced price transparency could facilitate more cost-conscious prescribing practices, potentially

improving access to essential treatments. Future studies aim to augment its functionality by incorporating a price comparison feature that enables users to compare medication prices from different community pharmacies.

Authorship contribution statement

NANNMS: Data analysis, Methodology, Formal analysis, Writing—original draft. **NANNMS:** Visualisation, Methodology, Writing – review & editing. **NAI, SA:** Visualization, Resources, Draft corrections. **NANNMS, NAI, SA:** Supervision, Funding acquisition, Writing – review & editing.

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Conflict of Interest

The authors declared that they have no conflicts of interest to disclose.

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Extended Abstract

MedSmart Exercise Book: Learn About Medicines While You Practice

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ABSTRACT

The MedSmart Exercise Book was developed to complement the Young Doctor Club (YDC) module's Know Your Medicine chapter, based on feedback from eleven primary school teachers with at least one year of YDC experience. A 45-minute focus group discussion (FGD) using the YDC module. The discussion followed a semi-structured interview guide, was audio-recorded, transcribed verbatim, and then thematically analysed using Nvivo application. Three key areas were identified for the exercise book's development: engaging content, universal accessibility, and time constraints. The Canva-designed exercise book covers three essential topics—What is Medicine, the 5R Concept, and Medicine Handling—within eleven pages, incorporating interactive elements like 'Match the Item,' 'Crossword Puzzle,' and 'Fill in the Spaces' to enhance student engagement. To improve accessibility, the book is available online, allowing students to test their understanding at their own pace, while attached answers support knowledge reinforcement. This digital format also addresses teachers' concerns regarding time constraints and access beyond extracurricular participants. The MedSmart Exercise Book has commercialisation potential due to its adaptability in classrooms and relevance to health education. Future expansions may explore licensing, subscriptions, and collaborations with government and non-government institutions to promote quality medicine use among schoolchildren.

Keywords: exercise guide, Know Your Medicine, medicine use, students, teacher

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1.0 Introduction

The Know Your Medicine (KYM) program was introduced in 2009 to support the fourth component of Malaysian National Medicines Policy (Dasar Ubat Nasional) focusing on the “quality use of medicines” (1). The main objective mainly stresses on ensuring that medicines are used rationally for better health outcomes (2). Multiple strategies are used to achieve the goals; among them are education, training, and providing accurate medicine information to the consumers. However, the 2015 National Survey on The Use of Medicine III by Malaysian Consumer (NSUM III) reported that despite the knowledge about the quality use of medicine is still lacking despite six years of the KYM program’s implementation, public knowledge about the quality use of medicines remains insufficient (3).

The KYM modules, which include topics such as “What is Medicine?” and “5R Use of Medicine” have been well-established and serve as key resources for public education. These topics have also been integrated into the Young Doctor Club (Kelab Doktor Muda) curriculum, a national extracurricular program in primary and secondary schools aimed at promoting healthy behaviors among students (4). While Harun et al. (5) reported that the Young Doctor Club module has successfully increased health knowledge among students, exploratory feedback from club advisors is essential to assess the module's practicality and its implementation during club events. A qualitative exploratory study was conducted among schoolteachers who act as Young Doctor Club's club advisor in primary schools around Kuala Selangor, Malaysia. The key concerns raised included the need for more engaging content, broader accessibility for students, and time limitations during club activities. To address these challenges, a complementary exercise module is required to enhance engagement,

ensure accessibility, and better fit within the time constraints of extracurricular programs.

2.0 Innovation

The MedSmart Exercise Book represents an innovative health education that is interactive and engaging for school students. By integrating the feedback from the schoolteachers, the content was made attractive and adaptable to diverse learning environments while also being personalised to address the educational needs of primary school children in Malaysia. The main highlights of the innovation are the engaging and interactive content such as the incorporation of activities such as 'Drag the Sticker into Correct Boxes' 'Crossword Puzzle,' and 'Fill in the Spaces'. Despite simplifying the topics for young minds to grasp complex ideas, it could help promote active learning and help the students retain key concepts about medicine. Another main highlight is its universal online accessibility, which could benefit broader users from the same age category by allowing them to learn and test their knowledge of medicine use.

3.0 Uniqueness

The MedSmart Exercise Book is a sustainable and relevant educational aid that helps in bridging the gaps of traditional health educational deliveries and modern teaching and learning curriculum in today’s world. It integrates seamlessly with the existing Young Doctor Club curriculum on Know Your medicine topic, reinforcing quality medicine use knowledge among primary school students. The exercise book's design is unique as its development is based on direct feedback from educators, ensuring it meets classroom needs. Its interactive design is unique as it integrates colourful images and elements with interactive activities such as 'Match the Item,' 'Crossword Puzzle,' and 'Fill in the Spaces'

that promotes active participation and self-directed learning among students. Furthermore, accessibility through online platforms allows students to engage with the material at their own pace.



Figure 1: MedSmart Exercise Book.

4.0 Commercialisation Potential

The current MedSmart Exercise Book that complements Chapter 11 of Know Your Medicine in Young Doctor Club only will be made free of charge to any student or institution to use for learning purposes. However, the exercise book chapters will further develop to allow more diverse KYM topics such as “Antibiotic Use and

Resistance” and “Medicine Use for Paediatric”. Due to its adaptability and appeal in education, it could be licensed for use to the Ministry of Health or Ministry of Education. The online format opens to subscription-based features for each topic to be unlocked by users for a small fee. Partnerships with local publishers and health NGOs could also help distribute the exercise book nationwide. Given their scalability in promoting health education in schools and beyond, these promising avenues provide opportunities to generate modest profits.

5.0 Impact on Quintuple Helix

The MedSmart Exercise Book could impact society by increasing knowledge, awareness, and practices of quality medicine use, encompassing its effective and safe use. This would promote healthy living among young people, thus improving their development and long-term health. In schools, this exercise book offers a modern, 21st century approach to learning among young students. Its interactive features and digitalised platform enhance accessibility, addressing gaps in traditional classrooms where health-related subjects struggle with time constraints and outdated teaching methodologies. The exercise book aligns with the government’s efforts to promote healthy behavior among students through the Young Doctor Club. It allows for self-assessment and reinforces knowledge gained from Chapter 11: 'Know Your Medicine' in the Young Doctor Club module. Furthermore, this innovation creates partnership opportunities with educational and healthcare organisations that aim to improve medicine literacy among school students. Lastly, digitalised features reduce paper usage while the content on proper medicine handling, storage, and disposal helps raise awareness about environmental protection and safe medicine disposal.

6.0 Conclusion

The MedSmart Exercise Book represents significant advancement in health education for young generations by offering an interactive, engaging and accessible tool to improve medicine literacy among Malaysian students. Its format and design address classroom challenges, thus making it usable beyond traditional educational settings. This exercise book has potential to positively impact public health, and its scalability opens up for global health education initiatives.

Authorship contribution statement

KJ: Data analysis, Methodology, Formal analysis. **NSH:** Visualisation, Methodology, Writing–original draft, Writing – review & editing. **IAZ, ZMN:** Visualization, Resources, Draft corrections. **HHZ:** Supervision, Funding acquisition, Writing – review & editing.

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Conflict of Interest

The authors declared that they have no conflicts of interest to disclose.

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Extended Abstract

Exploring the Potential of Graphene Oxide Functionalized with Ionic Liquid as Sorbent in Micro Solid Phase Extraction Towards Steroids in Water Sample

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ABSTRACT

Corticosteroids are widely used anti-inflammatory drugs but act as endocrine-disrupting compounds (EDCs), even at trace levels, posing serious health risks such as hormonal imbalances, reproductive issues, neurological disorders, and cancer. These contaminants enter water bodies mainly through improper disposal and household effluents, requiring efficient removal strategies. Conventional sorbents like silica have shown limited effectiveness, highlighting the need for a greener, more selective sorbent. Ionic liquids (ILs), with low volatility and high tunability, offer a promising approach to enhance sorbent performance. This study developed an Ionic Liquid-Graphene Oxide (IL-GO) sorbent for micro-solid phase extraction and evaluated its efficiency in removing hydrocortisone, dexamethasone, and fluocinolone acetonide from water samples. Results showed that IL-GO achieved significantly higher extraction efficiencies for hydrocortisone and fluocinolone acetonide, along with remarkable adsorption capacity for dexamethasone, outperforming GO alone. These findings demonstrate the potential of IL-GO as an effective and selective sorbent for corticosteroid removal, contributing to improved water quality and environmental safety.

Keywords: Graphene oxide, ionic liquids, selectivity, corticosteroids, green sorbent.

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1.0 Introduction

The occurrence of steroids in the aquatic environment and their potential effects have garnered significant attention among researchers and the public. This is because steroids are designed to be persistent and highly active towards human and animal receptors (1). Continuous discharge from various sources will eventually reach the wastewater treatment plants, which cannot effectively treat steroids due to their limited efficiency. This will amplify the impact of steroid contamination over time. According to the Guidelines for Drinking Water Quality by World Health Organization (WHO), routine monitoring of pharmaceuticals (including steroids) in drinking water is not considered necessary as the concentrations of these compounds are typically below the lowest therapeutic doses (2). However, long-term exposure to steroids has been shown to have detrimental effects on human health and the environment. Studies have demonstrated that steroids are susceptible towards mimicking the activity of endogenous hormones that can confuse the human body (3). Sample preparation is a vital step in analytical procedures, as it determines the accuracy and reproducibility of analytical results (4). Dispersive micro solid phase extraction (D- μ -SPE) is one of the sample preparation techniques used to extract steroids at trace concentrations, as it can effectively concentrate analytes in a short time (5). In this regard, a sorbent that is selective towards steroids should be developed for implementation with D- μ -SPE.

2.0 Innovation

The integration of ionic liquids (ILs) with graphene oxide (GO) offers a promising alternative sorbent for extracting specific

corticosteroid drugs—hydrocortisone (HYD), dexamethasone (DEX), and fluocinolone acetonide (FLA)—from aqueous solutions. This sorbent demonstrates a high affinity, effectiveness, and selectivity comparable to commercial sorbents. Combining a simple extraction method with the advantages of this novel material (IL-GO) is anticipated to successfully isolate and extract a wide range of steroid drugs with wide polarities in aqueous environments. Table 1 describes the advantages of graphene oxide (GO) and ionic liquids (ILs) that are implemented to innovate good sorbent with high selectivity and improved efficiency.

Table 1: The Features of GO and IL for the Sorbent Development

Materials	Features
Graphene oxide (GO)	- Rich in oxygen containing functional groups that form H-bond, π-π interactions and Van der Waals forces between sorbent and steroids (6). - High possibility to be functionalized with other materials to improve its features (5).
Ionic liquid (IL)	Improve the selectivity and sorption of material upon impregnation (7).

The efficiency of this sorbent was tested using 100 parts per billion (ppb) of HYD, DEX, and FLA. The peak areas for all corticosteroids, as shown in (b), exhibited higher intensity when the IL-GO sorbent was used in the D- μ -SPE technique, indicating that the IL successfully improved adsorption when impregnated onto GO. Meanwhile, the chromatogram comparison in (a) clearly demonstrated the elimination of interference peaks from the water sample.

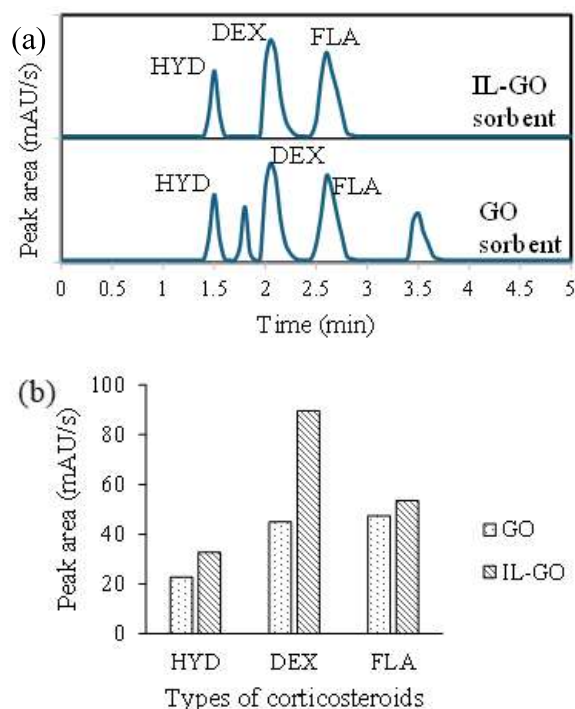


Figure 1: Comparison of corticosteroid extraction performance using Graphene Oxides (GO) and Ionic Liquid-GO (IL-GO) sorbents. (a) Chromatograms showing the separation of hydrocortisone (HYD), dexamethasone (DEX), and fluticasone (FLA) (b) the adsorption efficiency of IL-GO and GO sorbents.

3.0 Uniqueness

The integration of ILs with GO enables novel and innovative functionalization opportunities. ILs are known for their high cost. However, this innovation utilizes in-house ILs synthesized using inexpensive Brønsted acids and bases through a simple procedure. Furthermore, by impregnating ILs onto GO, the poor selectivity of the GO sorbent is enhanced, making it highly selective toward steroids. With the implementation of in-house ILs, a promising and effective IL-GO sorbent is realized at a significantly lower cost.

4.0 Commercialisation Potential

IL-GO sorbent offers significant commercial potential due to their superior ability to

selectively adsorb organic pollutants like steroids attributed to their large surface area and tuneable ionic liquids, which enhance efficiency over conventional sorbents (8, 9). Derived from abundant graphite and biodegradable ionic liquids, IL-GO minimizes waste and aligns with green practices (10). The application of this promising sorbent can also be expanded to various emerging contaminants (EC), making it highly applicable in diverse industries.

5.0 Impact on Quintuple Helix

The IL-GO sorbent profoundly impacts the Quintuple Helix framework, positively impacting society, academia, government, industry and, more importantly, the environment. It enhances public health by ensuring safer water and pharmaceutical products by effectively removing pollutants. In academics, it drives significant advancements in environmental and pharmaceutical research, fostering innovation. Governments rely on its efficacy to enforce stricter environmental regulations, promoting sustainability and public safety. Industries benefit from improved processes and product quality, while its environmental contribution lies in reducing contamination, supporting ecological preservation, and advancing sustainability. This sorbent is essential to modern social development across all sectors.

6.0 Conclusion

Over the past decade, the consumption of steroids has increased exponentially, driven by the discovery of new drugs and population growth. The continuous discharge of steroids will inevitably lead to adverse effects, if not managed thoughtfully. With the invention of this green and selective IL-GO sorbent, it is hoped to provide valuable information on steroid levels in local water bodies. This will

enable authorities and local communities to take serious actions toward raising awareness about steroid usage and disposal, as well as preserving the health of the ecosystem.

Authorship contribution statement

RMY: Laboratory work, data analysis, resource person, draft correction. **EE:** Visualization, novelty. **NR:** Innovation features, commercialization. **NSMH:** Supervision, funding acquisition. **MAAR:** Ionic liquid contributor. **MSM:** supervision, review & editing.

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Conflict of Interest

The authors declared that they have no conflicts of interest to disclose.

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Extended Abstract

PharmPathFinder: A Cost-Effective and Scalable Solution to Improve Pharmacy Students' Career Readiness

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ABSTRACT

Pharmacy students often struggle with fragmented learning about pharmacy professions due to the absence of a dedicated course. A survey at UiTM Malaysia revealed that 30% of students had only moderate or lower understanding, while 48% felt unprepared for their careers. A previous one-day program aimed at addressing this gap was costly and labour-intensive. To provide a more efficient solution, we developed PharmPathFinder, using the Plan, Do, Check, and Action (PDCA) tool with 21 steps. This mixed-method study incorporated surveys from alumni and students across four universities, alongside focus group discussions to refine the platform. After launching PharmPathFinder via TikTok, WhatsApp, and Facebook, 98.2% (275 students) expressed satisfaction, citing its usefulness and ease of use. Compared to the previous program, it reduced costs by 73%, time by 77%, and manpower by 75%. PharmPathFinder provides structured insights into four pharmacy specialisations and is accessible to students from their first year, regardless of location. Additionally, it is being promoted in secondary schools to introduce younger students to pharmacy careers.

Keywords: pharmacy, undergraduate students, profession, curriculum, innovation

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1.0 Introduction

PharmPathFinder was developed to address a critical gap in pharmacy education. The lack of a structured approach to exploring pharmacy professions limits students' ability to make informed career decisions and effectively transition into the workforce (1). Many pharmacy students struggle to gain a comprehensive understanding of the various fields within the profession, which leaves them uncertain about which specialisation suits them best (2, 3). The current curriculum at the undergraduate level lacks a focused course on pharmacy professions, and relevant information is scattered throughout the four years of study. This fragmented approach results in a lack of preparedness and insufficient knowledge, as evidenced by a survey conducted at the Faculty of Pharmacy, UiTM, Malaysia, where a significant percentage of students reported only a moderate or lower level of understanding. PharmPathFinder aims to provide a solution by consolidating all necessary information into one accessible platform.

The importance of PharmaPathFinder lies in its ability to streamline the learning process and offer students a more structured pathway to explore pharmacy specialisations. Previously, we implemented a one-day programme to expose students to the profession, but it was inefficient, consuming a significant amount of time, money, and human resources. PharmPathFinder addresses these inefficiencies and goes beyond, offering continuous access to professional insights throughout the students' academic journey. The platform was developed based on a thorough understanding of students' needs and expectations by incorporating a mixed-method study that includes feedback from alumni, current students, and focus groups from multiple universities. This feedback-driven approach ensures that

PharmPathFinder is relevant, engaging, and effective in delivering the required information.

PharmPathFinder's scope extends beyond just pharmacy students. Promoting the platform in secondary schools provides early exposure to the pharmacy profession, helping younger students make more informed decisions about their future studies. This early engagement is crucial for building interest in the profession and ensuring that future pharmacy students are better prepared when they enter university. Overall, PharmPathFinder represents an important innovation in education and healthcare by helping students better understand their career paths while significantly reducing the costs, time, and resources traditionally associated with professional exposure programs.

2.0 Innovation

This process showcases a systematic approach that combines research, stakeholder feedback, and technology to create an innovative and practical solution for pharmacy students to explore their professional paths effectively.

Identifying the problem: The first step was to recognise the challenges faced by pharmacy students at the Faculty of Pharmacy, UiTM, Malaysia, in accessing comprehensive and practical knowledge about various pharmacy professions. Surveys revealed that 30% of students had a moderate or lower understanding of the field, and 48% were not fully prepared to enter the profession. The findings highlighted the need for a more cohesive and accessible learning tool.

Research and Data Collection: We used a mixed-method approach to gather insights from various stakeholders, including alums, 1st to 4th-year pharmacy students, and focus group discussions across four universities.

This data helped identify key areas of improvement and design the structure of PharmPathFinder.

Designing the Platform: The platform was designed to provide continuous, user-friendly access to information about four pharmacy specialisations, replacing fragmented content dispersed across the curriculum.

Promoting Accessibility: A critical improvement involved creating a single QR code that links to a Linktree containing all necessary resources and information. This change addressed feedback suggesting that a unified QR code would make it easier for students to access all resources, eliminating the need to scan multiple codes individually from posters (Figure 1).

Social Media Promotion: PharmPathFinder was promoted through platforms like TikTok, WhatsApp, and Facebook, making it highly accessible to students. After its launch, user feedback indicated high satisfaction, with 98.2% of students reporting the tool as helpful and easy to use.

Cost, Time, and Manpower Savings: The platform demonstrated significant savings—reducing costs by 73%, time by 77%, and workforce by 75% compared to traditional exposure programs.

3.0 Uniqueness

PharmPathFinder is a unique innovation that addresses the challenge of fragmented learning in pharmacy education by offering a centralised platform for students to explore various pharmacy fields. Unlike traditional one-day programs or scattered coursework, PharmPathFinder provides continuous, self-paced access to information throughout a student's academic journey. We ground its development in a mixed-method research

approach, gathering feedback from alums, current students, and focus groups from multiple universities. This research-driven design ensures that the platform meets the real needs of students, making it a valuable, student-centred tool that enhances understanding and prepares them for future careers.

What sets PharmPathFinder apart is its modern use of technology and social media for promotion and accessibility. By leveraging platforms like TikTok, WhatsApp, and Facebook, PharmPathFinder reaches students where they are, making the platform easy to access and use. Additionally, the platform goes beyond university students by promoting pharmacy career exploration in secondary schools, giving younger students an early understanding of the profession. This combination of technology, research, and early exposure strategies makes PharmPathFinder a truly novel and effective solution in pharmacy education.

4.0 Commercialisation Potential

PharmPathFinder is designed as a free educational tool accessible to all pharmacy students in Malaysia. While the platform is fully developed and optimised to enhance pharmacy career awareness, it is not intended for commercial sale. Instead, it is an open-access resource supporting pharmacy education and career exploration (Figure 1). The project aims to benefit students without financial barriers, ensuring equal access to valuable career-related information. Institutions and educators are encouraged to integrate PharmPathFinder into their academic curriculum to maximise its impact on student learning and professional development.

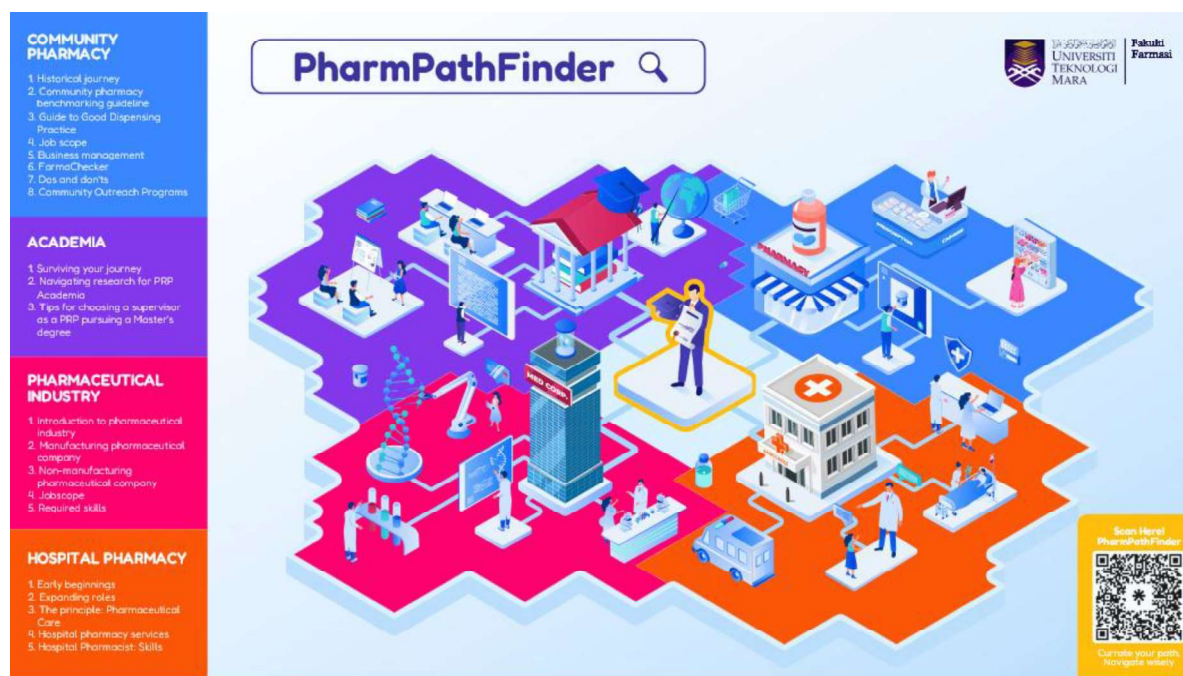


Figure 1: PharmPathFinder.

5.0 Impact on Quintuple Helix

PharmPathFinder raises awareness of the pharmacy profession, helping students make informed career choices and improving public health literacy. It enhances pharmacy education by providing a centralised resource for career exploration, promoting self-directed learning, and aligning content with industry needs.

The platform supports government public health initiatives by preparing a skilled pharmacy workforce and serving as a resource for policymakers. It benefits the pharmaceutical and healthcare industries by equipping students with the knowledge needed for internships and job placements. PharmPathFinder also promotes sustainability by reducing the need for printed materials and travel, minimising the carbon footprint of pharmacy education.

6.0 Conclusion

PharmPathFinder is a transformative innovation in pharmacy education that

addresses the challenges students face in understanding the diverse fields within the profession. By offering a centralised and accessible platform, it enhances learning experiences and empowers students to make informed career decisions. Developed through thorough research and stakeholder feedback, PharmPathFinder strengthens the connection between academia and the pharmaceutical industry while preparing secondary school students for future careers in pharmacy. Additionally, it aligns with government public health initiatives and promotes sustainability by reducing environmental impact. The positive feedback from users highlights its effectiveness and underscores the importance of ongoing innovation in education to meet the evolving demands of the healthcare landscape.

Authorship contribution statement

NFMR, NWZ: Data analysis, Methodology, Formal analysis, Writing—original draft. **NEAH, JAJ:** Visualization, Methodology, Writing – review & editing. **NANNMS,**

NFD, MSAW: Visualisation, Resources, Draft corrections. **NWZ:** Supervision, Funding acquisition, Writing – review & editing.

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Conflict of Interest

The authors declared that they have no conflicts of interest to disclose.

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Extended Abstract

BurnBLITZ Version II: A Personalised Fitness App Revolutionising Exercise and Combating Obesity Among University Students

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ABSTRACT

With Malaysia facing one of the highest obesity rates in Southeast Asia (20.1% of adults are classified as obese), fitness apps have gained popularity as tools to promote healthier lifestyles. BurnBLITZ Version II (V2), a personalised exercise app, was developed to address obesity among university students by offering tailored workout plans, instructional videos, and cloud-based updates for safe and effective training. A trial involving 150 students selected based on body mass index (BMI) and willingness to volunteer was conducted. Participants were divided into two groups: one using the apps ($n=75$) and a control group ($n=75$). Pre- and post-tests assessing cardiovascular fitness, muscular strength, and endurance significantly improved in the app-assisted group ($p<0.05$). Unlike typical fitness apps, BurnBLITZ V2 provides expert consultations, offering personalised guidance to enhance user engagement and motivation. This feature makes it particularly beneficial for university students with busy schedules, helping them integrate exercise into daily routines. By addressing common fitness barriers like time management and commitment, BurnBLITZ V2 presents a promising solution for combating obesity through accessible, engaging, and personalised fitness support.

Keywords: Burnblitz app, correct exercise, health and fitness, exercise guidance, fitness app.

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1.0 Introduction

The demanding and stressful lifestyle of university students, characterised by long study hours, irregular schedules, and limited opportunities for physical activity, often results in unhealthy eating habits and sedentary behaviour, ultimately increasing their risk of obesity (1,2). As technology advances and digital transformation grows (3), Pradal-Cano *et al.* (2020) (4) has suggested that mobile apps can potentially improve health outcomes and may be recognised as cost-effective, scalable interventions. Considering rising obesity rates, integrating new technologies is both timely and crucial for revolutionising healthcare and promoting healthier living (5). Supporting this, Al-Nawaiseh *et al.* (2022) (6) have demonstrated that mobile apps are particularly effective in driving behaviour change, especially in addressing lifestyle risk factors such as physical activity. BurnBLITZ Version V2 (Figure 1), a personalised fitness app built on the Adalo platform, provides a user-friendly tool for students to combat obesity by promoting regular exercise and reducing obesity-related health issues

2.0 Innovation

BurnBLITZ V2 offers a progressive fitness experience, starting with basic exercises and gradually incorporating weight training and recovery phases. The app features personalised workout plans, interactive content, expert guidance, and community support (Figure 1). The "Choose Your Sport" option allows users to customise their workouts based on their preferences. Cloud-based updates ensure the app remains aligned with the latest exercise science, making it an effective tool for promoting healthy living and long-term fitness success.

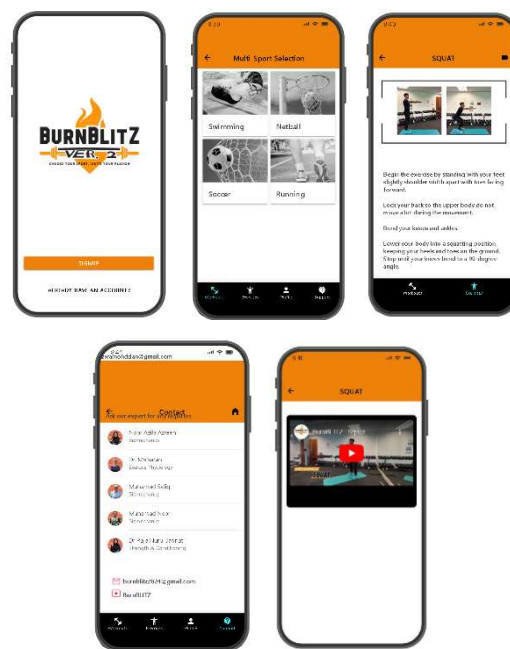


Figure 1: User interface of BurnBlitz Version II.

3.0 Uniqueness

Unlike most fitness apps, BurnBLITZ V2 offers expert consultations and comprehensive guidance to motivate users and ensure proper exercise form. Combining written instructions, pictures, and videos, this multi-format approach ensures effective exercise execution, like following a medical regimen (3, 4).

4.0 Commercialisation Potential

BurnBLITZ V2's commercial potential is driven by increasing demand for fitness solutions and its adaptability, affordability, and alignment with current trends. During the development process, the developer had already secured partnerships with several companies to enhance the features further and market the apps. Besides that, the future update also includes gamification elements, further enhancing its value to be sold as a premier app to aid fitness and boost a healthy lifestyle. Other than that, developers are also in the process of tying some knots with

fitness celebrities to be the experts in the apps. The best part of this app is that it will also be in multiple formats and can be used by all handheld devices out there.

5.0 Impact on Quintuple Helix

BurnBLITZ V2 can impact various sectors, including society, academia, government, the fitness industry, and the environment. By promoting healthier lifestyles, reducing obesity, and supporting public health initiatives, the app offers a valuable solution to address these critical issues.

6.0 Conclusion

BurnBLITZ V2 offers a comprehensive solution to promote healthier lifestyles and address the growing obesity crisis. By aligning with public health goals, supporting academic research, and fostering innovation in the fitness industry, the app can significantly impact various sectors.

Authorship contribution statement

NAMR and **MNM**: The technical development, ensuring the app's functionality and user-friendliness; **RNJRH** and **MAA**: Content and design, crafting engaging exercises and a visually appealing interface; **MSSA** and **MS**: Wrote the academic paper, providing a theoretical framework and empirical evidence to support the app's effectiveness. Their expertise and dedication contributed significantly to the app's success and the quality of the academic work.

Acknowledgments

We would like to express our sincere gratitude to all those who contributed to the development of the BurnBLITZ V2 app. Their expertise, dedication, and support were invaluable in bringing this project to fruition. We would also like to thank UiTM and FSR

for providing resources and support. Their encouragement and belief in our vision were instrumental in the success of this project. Finally, we would like to extend our heartfelt thanks to the dedicated volunteers who generously gave their time and energy to this endeavour. Their enthusiasm and commitment were essential in making BurnBLITZ V2 a reality.

Conflict of Interest

The authors declared that they have no conflicts of interest to disclose.

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Extended Abstract

Ez-CapOff: One-Handed Needle Cap Removal

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ABSTRACT

Needle stick injuries (NSIs) among healthcare workers including nurses and nursing students present a significant safety risk, highlighting the urgent need for effective solutions to mitigate this preventable hazard. The Ez-CapOff is an innovative tool designed to simplify the removal of needle caps, thereby transforming nursing practices worldwide. With a focus on ergonomics and efficiency, the Ez-CapOff allows nurses to remove needle caps with one hand, significantly reducing the time and effort required for this routine task. Traditional methods of needle cap removal often necessitate the use of both hands, posing challenges for nurses who must maintain sterility while multitasking in fast-paced healthcare environments. The Ez-CapOff eliminates this cumbersome process by integrating intuitive design features that enable seamless, one-handed operation. Leveraging innovative mechanisms and materials ensures secure and reliable cap removal without compromising safety or hygiene. Additionally, the Ez-CapOff enhances workflow efficiency, empowering nurses to perform their duties more easily and confidently. It also promotes patient safety by minimizing the risk of accidental needle stick injuries, a persistent concern in clinical settings. A prototype survey of 24 nursing students aged 20 to 24 revealed that approximately 70% experienced difficulties handling syringes and needles for the first time during lab practice. Notably, over 80% responded positively towards using the Ez-CapOff, with more than 70% indicating they would likely purchase the product for their use. In conclusion, the Ez-CapOff represents a significant advancement in needle cap removal, offering a practical solution to enhance nursing efficiency, safety, and overall quality of care. As healthcare continues to evolve, the Ez-CapOff is poised to become an indispensable tool in modern nursing practice, setting new standards for innovation and patient-centred care.

Keywords: cap removal, injection, needle, needle stick injuries syringe (NSI)

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1.0 Introduction

Needle stick injuries (NSIs) are a significant safety concern for healthcare workers (HCWs), particularly nurses and nursing students, due to their frequent handling of syringes and sharp instruments. Xu Xu *et al.* (2022) (1) found that nursing students accounted for 35% of reported needle-stick injuries, while 63% did not report their injuries. Efforts to prevent needle-stick injuries must be strengthened, as only 54.55% of nurses reported using gloves injection, 90.91% sustained injuries due to carelessness, and 27.27% continued the unsafe practice of recapping needles (2). Despite preventive measures, NSIs remain common in healthcare environments, highlighting the urgent need for innovative safety solutions.

2.0 Innovation

Traditional methods of needle cap removal often necessitate the use of both hands, posing challenges for nurses who must maintain sterility while multitasking in fast-paced healthcare environments. Recapping needles is also one of the actions that may cause NSIs among HCWs. So, this innovation was ideated to help them easily remove and recap needles with only one hand, significantly reducing time and effort and also helping to prevent NSIs. The Ez-CapOff was designed using a special clay that sticks together which can hold the needle cap firmly during removal or recapping the needle (Table 1). It was designed in a round shape with a diameter of 3.5 cm, in various vibrant colours, which is placed in a plastic casing. It can also serve as a decorative device.

3.0 Uniqueness

Based on a literature search, limited information and research focusing on similar

products available in Malaysia. The uniqueness of this product depends on its sticky component that holds the needle cap firmly. It can be placed on many flat surfaces including metal, plastic, wood and glass, reusable and the clay does not stick to fingers.

Table 1: The Ez-CapOff

Item	Description
Ez-CapOff 	• Round shape • Diameter of 3.5 cm • Vibrant colours with abstract design
Ez-CapOff in plastic casing 	• Encased in plastic for moisture protection. • Available in black and white casings. • Variety of vibrant colours and designs • Can be displayed as decorative piece.

3.1 Prototype Survey

This project involved a survey targeting a prototype among 24 nursing students aged 20 to 24, focusing on their experiences during laboratory practice with syringes and needles. The findings indicated that approximately 70% of the participants encountered challenges when handling these medical instruments for the first time. This suggests a significant level of difficulty and potential risk associated with needle handling among novice healthcare providers.

Furthermore, the survey assessed the students' perceptions of the **Ez-CapOff** tool, revealing a notably positive reception. Specifically, over 80% of the respondents expressed favourable opinions about using the **Ez-CapOff** during their training (Figure 1). Additionally, more than 70% of the

participants indicated a likelihood of purchasing the product for personal use, reflecting a strong interest in adopting tools that enhance safety and efficiency in needle handling. These results underscore the potential of the **Ez-CapOff** to improve the educational experience of nursing students while also promoting safer practices in clinical settings.

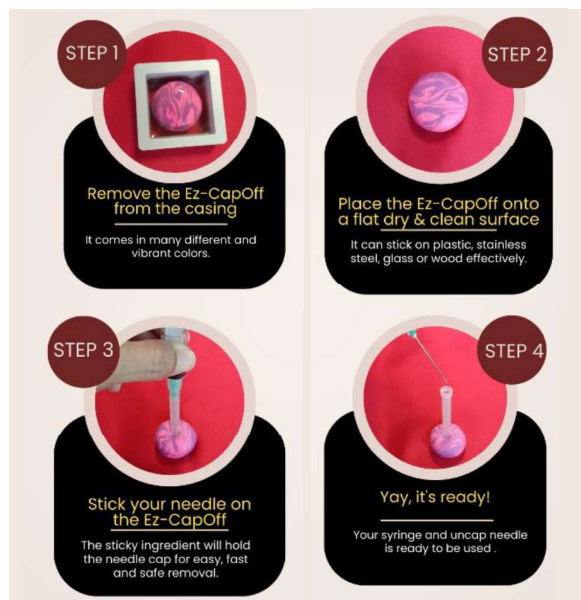


Figure 1: Steps of using the Ez-CapOff.

4.0 Commercialisation Potential

The Ez-CapOff has huge potential to be commercialized due to its convenience and purpose in assisting healthcare workers in handling needles and syringes. It also plays an important role for health care providers such as doctors, nurses, pharmacists, phlebotomists, medical laboratory technologists, educators and students in the medical and health sciences study.

5.0 Impact on Quintuple Helix

5.1. Society

The Ez-CapOff helps protect healthcare workers from needle stick injuries (NSIs), reducing the risk of dangerous infections like

HIV and hepatitis. Preventing these injuries, improves worker safety, saves healthcare costs, and promotes better public health.

5.2 Academia

In education, the Ez-CapOff is a useful tool for teaching safe needle handling. It helps students learn better safety practices and encourages research on healthcare safety and ergonomics, making it an important resource in nursing and medical schools.

5.3 Government

For governments, the Ez-CapOff can lower healthcare costs related to treating NSIs and support workplace safety regulations. It aligns with public health initiatives aimed at preventing infections and helping create safer healthcare environments.

5.4 Industry

In the healthcare industry, the Ez-CapOff reduces workplace injuries, leading to fewer compensation claims and improving efficiency. It also offers new opportunities for medical device manufacturers and encourages innovation in creating safer healthcare tools.

5.5 Environment

The Ez-CapOff can help reduce medical waste by preventing NSIs and cutting down on contaminated sharps. Made from sustainable materials, it can also lessen the environmental impact, especially if it's reusable or long-lasting.

6.0 Conclusion

The Ez-CapOff represents a significant advancement in needle cap removal, offering a practical solution to enhance nursing efficiency, safety, and overall quality of care.

As healthcare continues to evolve, the Ez-CapOff is poised to become an indispensable tool in modern nursing practice, setting new standards for innovation and patient-centered care.

Authorship contribution statement

The author confirms that she is the sole contributor to the work presented in this manuscript. The author independently conducted all stages of the project, including the conception, design, data collection, analysis, and interpretation, as well as the drafting and revising of the manuscript.

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Conflict of Interest

The authors declared that they have no conflicts of interest to disclose.

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Extended Abstract

Molecular Docking Analysis of Repurposed HIV And Antiviral Drugs Against Monkeypox Target Protein: Evaluating Docking Scores and Hydrogen Bond Interactions

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ABSTRACT

The rising threat of monkeypox has driven efforts to repurpose existing HIV and antiviral drugs using *in silico* molecular docking for cost-effective and rapid drug discovery. This study evaluated the binding affinities and hydrogen bond interactions of HIV drugs (Atazanavir, Darunavir, Fosamprenavir, Lopinavir, Ritonavir) and antiviral agents (Brincidovir, Favipiravir, Galidesivir, Remdesivir, Ribavirin) against a monkeypox protein target (PDB ID: 8B07). The four-step molecular docking workflow included target protein preparation, ligand preparation, docking simulation, and interaction visualisation. Results showed that HIV drugs had higher docking scores, with Lopinavir (-10.6) and Atazanavir (-10.1) emerging as top candidates, while antiviral agents displayed lower affinities (Remdesivir: -6.6). The study highlights the advantages of computational drug screening for rapid drug identification. The strong hydrogen bond interactions of Lopinavir and Atazanavir with the monkeypox protein suggest their potential for therapeutic repurposing. This research underscores the applicability of computer-aided drug design (CADD) in accelerating drug discovery. Further experimental and clinical validation is necessary to confirm efficacy. These findings provide a framework for repurposing drugs against emerging viral infections, offering a strategic approach to public health preparedness.

Keywords: Docking score, Drug repurposing, Emerging viral threats, Molecular docking, Monkeypox

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1.0 Introduction

The emergence and recurrence of viral diseases, such as COVID-19, Ebola, and Zika, present significant global health challenges due to their high infectivity, constant mutation, and resistance to conventional treatments. Monkeypox, a viral disease caused by the Orthopoxvirus related to the variola virus (responsible for smallpox), has recently garnered global attention due to its outbreaks in non-endemic regions (1). Although vaccines and supportive care are available for monkeypox, no direct antiviral treatments currently exist. The development of new antiviral agents typically demands significant time and financial resources, making it difficult to respond promptly during emerging outbreaks.

This scenario underscores the importance of drug repurposing a strategy that seeks new therapeutic uses for drugs already approved for human use (2). Notably, certain HIV drugs, such as protease inhibitors and reverse transcriptase inhibitors, have been shown to exhibit broad-spectrum antiviral activities by targeting conserved replication pathways in different viruses. Given the similarities in viral replication mechanisms between HIV and monkeypox, these drugs present a promising option for repurposing to treat monkeypox (3).

Due to the rising incidence of monkeypox worldwide, computational approaches like molecular docking have gained significance in evaluating the binding affinity between potential drug candidates and viral proteins. Molecular docking enables researchers to predict the binding affinities of chemical compounds, providing insight into their potential effectiveness as therapeutic agents (4). This study leverages molecular docking to assess the binding interactions of selected HIV (Atazanavir, Darunavir, Fosamprenavir, Lopinavir, and Ritonavir) and antiviral

agents (Brincidovir, Favipiravir, Galidesivir, Remdesivir, and Ribavirin) against a specific monkeypox protein target (PDB ID: 8B07) thereby exploring the feasibility of repurposing these drugs.

The study's findings revealed that certain HIV drugs, particularly Lopinavir and Atazanavir, exhibit higher binding affinities and stronger hydrogen bond interactions with the monkeypox protein target, indicating their potential as repurposed therapies. This research not only addresses the urgent need for effective monkeypox treatment options but also highlights the broader applicability of computational drug design for other emerging viral diseases.

The outcomes of this study could inform future experimental research and optimise methodological approaches in clinical trials, thereby contributing to an enhanced international response to monkeypox and other orthopoxvirus infections (5). By establishing a foundation for computational drug repurposing strategies, this work supports public health efforts to develop rapid therapeutic interventions during viral outbreaks and sets a precedent for addressing similar challenges in the future.

2.0 Innovation

Drug repurposing offers a streamlined approach to drug development by leveraging the established safety and efficacy profiles of existing drugs, thereby reducing costs, development timelines, and the risk of failure (2). This strategy bypasses early discovery phases and simplifies regulatory procedures, increasing the probability of successful market introduction (6). Repurposed drugs require fewer resources and less time to reach the market, making them a cost-effective option compared to traditional development pathways (7). The known pharmacokinetic and pharmacodynamic profiles of these drugs facilitate a smoother transition through later

development stages, providing more affordable and faster treatment options (2).

Beyond economic and time efficiencies, drug repurposing also addresses public health needs by offering new therapies for diseases with limited treatment options, such as rare or neglected conditions (3). Moreover, it supports sustainable development by reducing the need for new drug synthesis, thus minimising chemical waste and environmental impact (1). This approach also enables pharmaceutical companies to explore new therapeutic applications for existing drugs, creating opportunities for expanding their market presence (5).

In response to the growing threat of monkeypox, researchers turned to drug repurposing using *in silico* molecular docking to explore existing HIV and antiviral drugs. Targeting the monkeypox protein (PDB ID: 8B07) (8), the study revealed that HIV drugs (Table 1) (9), particularly Lopinavir and Atazanavir, showed stronger binding affinities (-10.6 and -10.1, respectively) compared to antivirals (10,11). Lopinavir, forming four hydrogen bonds with key residues, demonstrated the most stable interaction, while Remdesivir, the top antiviral candidate, showed a docking score of -6.6 with three hydrogen bonds (12, 13). The number and strength of hydrogen bond interactions were key indicators of potential efficacy. These findings highlight the promise of Lopinavir and Remdesivir as repurposed treatments for monkeypox, showcasing the power of computer-aided drug design (CADD) to fast-track therapeutic discovery during outbreaks (14). Though further validation is needed, this research offers a practical framework for applying AI-driven repurposing strategies to emerging viral diseases, bridging science and speed in global health response.

Table 1: Molecular Docking Results and Hydrogen Bond Interactions of HIV and Antiviral Drugs Against Monkeypox Target Protein (PDB ID: 8B07) using computational approaches.

Drug	Score	Hydrogen Bond Interactions
Atazanavir	-10.1	3 hydrogen bonds with GLU299, THR232, and SER207
Darunavir	-9.3	4 hydrogen bonds with ASP245, GLY300, and ASN301
Fosamprenavir	-8.8	2 hydrogen bonds with HIS227 and THR232
Lopinavir	-10.6	4 hydrogen bonds with THR232, GLU299, and GLY300
Ritonavir	-9.3	3 hydrogen bonds with ASN301, GLY300, and ASP245
Brincidovir	-6.5	2 hydrogen bonds with GLU299 and ASN301
Favipiravir	-5.8	1 hydrogen bond with GLY300
Galidesivir	-5.8	2 hydrogen bonds with ASP245 and GLU299
Remdesivir	-6.6	3 hydrogen bonds with GLU299, ASN301, and GLY300
Ribavirin	-6.9	2 hydrogen bonds with GLU299 and ASP245

3.0 Uniqueness

This study presents a novel approach by utilising *in silico* molecular docking to evaluate the potential repurposing of HIV and antiviral drugs against a specific monkeypox protein target. The originality of this research lies in its innovative use of computational methods to identify promising drug candidates for monkeypox treatment. By focusing on HIV drugs with broad-spectrum antiviral properties, the study addresses an urgent need for effective monkeypox therapies, offering a potential solution without the time and cost constraints associated with traditional drug discovery (Figure 1). The comprehensive analysis of

docking scores and hydrogen bond interactions further contributes to the uniqueness of this research, as it establishes a foundation for identifying repurposed drugs that can be rapidly implemented for clinical use in future monkeypox outbreaks. This strategy not only provides a practical approach for addressing emerging viral diseases but also demonstrates the potential of computational drug design in accelerating the discovery of therapeutic options for underexplored viral targets.

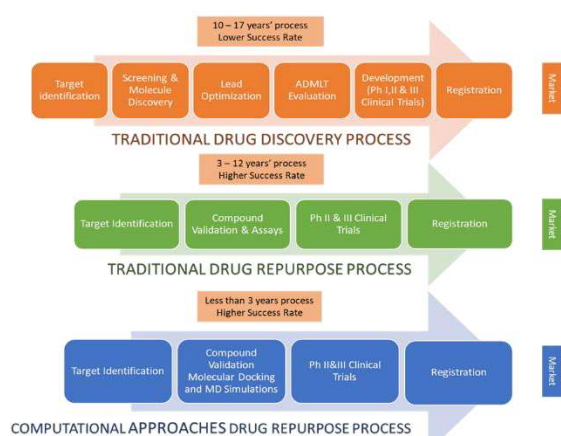


Figure 1: Comparison of methodologies, timelines, processes, and success rates of three different approaches.

4.0 Commercialisation Potential

The findings from this study suggest a strong commercialisation potential for repurposed HIV drugs, particularly Lopinavir and Atazanavir, as treatments for monkeypox. The high docking scores and favorable hydrogen bond interactions demonstrated by these drugs indicate their potential efficacy against the monkeypox virus. This creates an opportunity to reposition these existing pharmaceuticals for an emerging health threat, providing a quicker path to market compared to traditional drug development.

Given that Lopinavir and Atazanavir are already approved and widely used for treating HIV, their known safety and pharmacokinetic profiles could significantly

streamline the regulatory approval process for their new indication against monkeypox. This would allow for a rapid market entry, reducing development costs and timelines while meeting an urgent therapeutic need. Additionally, the established manufacturing and distribution infrastructure for these drugs can further support their quick deployment and commercialisation for monkeypox treatment.

Furthermore, drug repurposing reduces the financial risk associated with early-stage drug discovery and presents an economically viable solution for pharmaceutical companies looking to expand their market portfolios. The demonstrated effectiveness of computational methods, such as the *in-silico* docking approach used in this study, can facilitate cost-effective screening of additional compounds for other viral infections, broadening the commercial scope of this research.

In summary, the commercialisation potential of repurposing HIV drugs for monkeypox treatment is considerable, given the existing regulatory approvals, safety profiles, and manufacturing capabilities. This approach could accelerate market availability, meet a pressing public health need, and create new business opportunities for the pharmaceutical industry. Further experimental validation and clinical trials would be the next step to fully realise this potential and establish a novel therapeutic option for managing monkeypox outbreaks.

5.0 Impact on Quintuple Helix

5.1 Society

Repurposing HIV drugs for monkeypox offers timely, accessible treatment during outbreaks, reducing disease burden and improving public health. Using well-known drugs fosters patient trust and societal resilience against emerging threats.

5.2 Academia

This study advances the use of *in silico* molecular docking in drug repurposing, promoting interdisciplinary research in computational drug design and encouraging further exploration across virology, pharmacology, and bioinformatics.

5.3 Government

Repurposing supports faster regulatory approval and public health response, aligning with national preparedness goals. It enables governments to act swiftly using safe, pre-approved treatments during health emergencies.

5.4 Industry

Pharmaceutical companies benefit from lower R&D costs and faster commercialisation by repurposing existing drugs. This creates new revenue streams and encourages innovation by expanding drug applications.

5.5 Environment

By reducing the need for new chemical synthesis, drug repurposing lowers carbon emissions and chemical waste. It promotes sustainable practices by maximising the utility of existing pharmaceutical resources.

6.0 Conclusion

This study reveals the promising potential of repurposing HIV drugs, particularly Lopinavir and Atazanavir, as immediate therapeutic solutions for monkeypox. Using a novel *in silico* molecular docking approach, these drugs demonstrated strong interactions with the monkeypox protein target, highlighting their viability for rapid deployment. This innovative strategy significantly reduces development time,

costs, and risks, while addressing a critical public health need. The results lay a strong foundation for advancing clinical research and revolutionising how we respond to emerging viral threats, offering a transformative approach to accelerate drug discovery and enhance global health preparedness.

Authorship contribution statement

NBR, SNAH, EASA: Data analysis, visualisation, Resources, **NSN:** Writing-review, Resources. **NAS:** Supervision, Funding acquisition, Methodology, Writing, review & editing, correction draft.

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Conflict of Interest

The authors declared that they have no conflicts of interest to disclose.

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