

Pharmacy Management System with Online Ordering Data Visualization

Mary Ann Item, John Jerick Magsino, Roberto Aquino Jr. & Marlon Atienza

The widespread adoption of technology has transformed nearly every aspect of human life, delivering significant benefits to society, particularly in healthcare and business operations (Silberglitt & Antón, 2020). In inventory management, tracking the location and movement of products throughout the supply chain is essential. Technology ensures transparency and accountability, strengthening a company's competitive edge (Martínez-Peláez et al., 2023; Noor, 2022). Inventory management systems support this process by monitoring stock inflows and outflows, tracking product availability, and ensuring timely order fulfillment from selection to delivery. By applying best practices and leveraging advanced technology, warehouses can reduce losses, prevent product damage, and manage expiration dates more effectively (Adeodu et al., 2023; Rahman & Kirby, 2024; Khedr & Rani, 2024).

Data analytics further enhances operational decision-making. It encompasses tools and technologies for managing both qualitative and quantitative data to extract insights, support governance, and inform organizational strategies (Pancić et al., 2023; Pisoni et al., 2024). Within

business and healthcare contexts, analytics identifies trends in product use, consumer behavior, and operational inefficiencies, thereby facilitating more strategic management and targeted marketing decisions (Ahmed et al., 2024; Rosário & Dias, 2023). In e-commerce, customers must share sensitive financial and personal data, raising concerns about fraud, identity theft, and financial loss. Successful online payment processing typically involves three actors: the merchant, the payment platform, and the customer. Addressing security concerns and ensuring seamless transaction flows are crucial to building consumer trust and minimizing shopping cart abandonment.

Pharmacy management systems illustrate the advantages of technological integration in healthcare. These systems improve efficiency, accuracy, and patient care by automating routine processes. Meknassi et al. (2025) found that such systems significantly reduced both medication distribution times and errors, while Bialas et al. (2020) highlighted improvements in inventory management and the reduction of stockouts. Moreover, online ordering features increase convenience and customer satisfaction (Pabba et al., 2025; Bahamdan & Almanasef, 2024).

Pharmacies serve a critical role in ensuring proper medication administration and providing patient guidance, all while adhering to strict regulatory standards. The use of pharmacy management systems streamlines operations, reduces errors, and supports personalized care. Web-based platforms managed by licensed pharmacists also expand access to patients with mobility challenges, including nursing mothers and individuals requiring long-term medication. Features such as automated monitoring of fast-moving or soon-to-expire drugs further strengthen operational oversight and inventory management.

The pharmacy sector in Sariaya, Philippines, demonstrates a

pressing need for such technological intervention. Of 59 registered pharmacies, only 34 currently hold active licenses, and just six use sales and inventory systems. The majority still depend on manual recordkeeping, and none offer online ordering or delivery services (fda.gov.ph). This gap highlights the importance of adopting modern web-based pharmacy management systems to improve sales processes, strengthen inventory control, and enhance customer convenience. Hence, this study recognizes the potential benefits of transitioning to an online Pharmacy Management System. Such a system would allow customers to place orders conveniently online while enabling the pharmacy to optimize internal processes. It would also facilitate regular inventory updates, track medication flow, and provide real-time stock information for both staff and customers.

By addressing the operational limitations of pharmacies in Sariaya, the proposed system seeks to improve efficiency, ensure reliable client services, and enhance overall pharmaceutical operations. The study's primary objective is to design and develop a web-based pharmacy management system with online ordering and data visualization.

Theoretical Framework

The Role of Technology in Pharmacy Administration

The evolution of technology has fundamentally reshaped pharmacy management, driving improvements in both operational efficiency and patient care. Bialas et al. (2020) underscore how integrated systems streamline workflows and boost productivity, enabling pharmacists to dedicate more time to high-quality patient care by automating tasks such as medication dispensing, stock management, and billing. Similarly, Mason et al. (2022) emphasize the importance of robust technological systems for

accurate stock monitoring and analysis, which ensure the timely availability of essential medications and support safer drug administration.

Alanazi et al. (2022) demonstrate that automated dispensing systems significantly reduce medication errors, thereby enhancing patient safety. Complementing this, Hamad and Bah (2022) highlight the role of electronic health records (EHRs) in improving medication reconciliation, strengthening communication among healthcare providers, and enabling personalized pharmaceutical care. Khare (2025) shows that telepharmacy services expand healthcare access in underserved areas, allowing pharmacists to provide consultations and dispense medications remotely. Furthermore, mobile health (mHealth) applications reinforce medication adherence by sending reminders and offering guidance, empowering patients to take an active role in managing their therapies (Peng et al., 2020). Porterfield et al. (2014) add that electronic prescribing systems reduce errors, improve inter-professional communication, and accelerate prescription processing.

These studies establish that technology not only improves medication safety and operational efficiency but also advances patient-centered care, positioning technological innovations as indispensable drivers of modern pharmacy administration.

Electronic Commerce and Online Drugstores

The rapid expansion of e-commerce has profoundly influenced the pharmaceutical sector, transforming how patients access medications and healthcare services. Houcheimi and Mezei (2024) highlight the convenience of online ordering and its potential to broaden market reach, stressing that secure payment methods are essential to building consumer trust. Varghese et al. (2025) identify perceived usefulness, ease of use, and platform

reliability as key determinants of consumers' willingness to adopt online pharmacy services. Likewise, Zacharia et al. (2024) emphasize e-commerce's role in accelerating healthcare innovation, enhancing patient engagement, and improving accessibility, while also underscoring the need for effective regulation and quality control.

Almeman (2024) demonstrates that online pharmacies not only facilitate access to essential medicines but also improve adherence and empower patients to participate more actively in healthcare decisions. Taken together, these findings underscore that while online pharmacies offer convenience, market expansion, and better patient outcomes, their sustainability relies heavily on trust, robust security, and strong regulatory compliance.

Pharmaceutical Information Visualization and Analytics

Pharmacy operations generate vast amounts of data, making data visualization and analytics critical for efficient decision-making. Eberhard (2023) argues that visual data representations enhance comprehension and inform actionable insights. Fatorachian and Pawar (2025) demonstrate that predictive modeling and demand forecasting optimize inventory management, reduce waste, and improve supply chain efficiency. Similarly, Babel et al. (2021) show how analytics can strengthen medication therapy management by detecting drug-related issues, improving adherence, and optimizing treatment outcomes.

Shahmoradi et al. (2021) further highlight that integrating clinical decision support systems with analytics enhances patient safety, minimizes prescription errors, and supports evidence-based decision-making in pharmaceutical practice. Collectively, these studies confirm that data visualization and analytics are powerful tools for improving inventory

control, medication management, and clinical outcomes in pharmacy administration.

Designing and Deploying a System

The design and deployment of pharmacy management information systems require careful attention to user requirements, system customization, and adequate staff training. Dopp et al. (2020) stress that aligning system design with user needs is critical to achieving successful implementation. Staras et al. (2021) add that clinical eHealth interventions streamline workflows, improve resource allocation, and enhance automation across healthcare facilities. Hence, there is a need to address technical, organizational, and usability challenges to secure user acceptance and system effectiveness.

Kroenert and Bertsche (2024) emphasize the importance of collaboration and the removal of implementation barriers to establish robust research and technological infrastructure in pharmacy settings. Moreover, Ezeamii et al. (2024) illustrate how pharmacy-led virtual clinics extend healthcare services through telemedicine, expanding access and improving patient outcomes. Collectively, these studies indicate that successful system deployment hinges on planning, collaboration, training, and a strong focus on usability.

Security and Privacy in Online Pharmacy Systems

As online pharmacy systems become increasingly widespread, ensuring security and privacy emerges as a critical concern. Kuzma (2011) highlights the risks inherent in online platforms, particularly regarding data protection, secure payments, and compliance with regulatory standards. Kumar et al. (2024) propose secure system architectures that protect

sensitive patient data through encryption, access controls, and audit trails. Similarly, Folorunso et al. (2024) advocate for strong authentication protocols, regular security audits, and operational safeguards to reduce the likelihood of breaches.

Alhuwail et al. (2021) present a comprehensive security framework for online pharmacies, emphasizing the prevention of cyberattacks, protection of personally identifiable health information, and secure communication channels. Collectively, these studies affirm that stringent security measures are essential for protecting patient confidentiality, ensuring system reliability, and fostering public trust in online pharmacy platforms.

Research Framework

This section outlines the methodology used for developing and testing the proposed system.

Data

The following types of data were utilized in the development and testing of the pharmacy management system:

Customer records: Name, contact information, delivery address

Product information: Name, description, price, stock quantity

Order data: Order ID, customer ID, product ID, quantity, date, and time

Payment information: Payment method, transaction ID, amount

Inventory data: Stock levels, reorder points, supplier information

Sales data: Sales trends

User accounts: Pharmacy administrators, customers

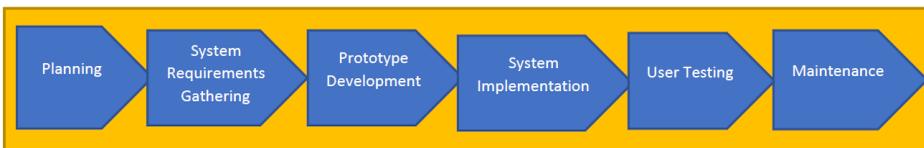
Data collection was conducted through surveys, interviews, observations, and review of existing databases. Quantitative data were gathered via surveys from a representative sample, while qualitative insights were obtained through interviews with key stakeholders. Observations of pharmacy workflows identified inefficiencies, and historical data analysis supported informed decision-making. Data collection involved electronic questionnaires, interview notes, and field observations, with strict adherence to confidentiality and secure storage protocols. This data-driven approach ensured the system addressed stakeholder requirements and improved operational efficiency.

Experimental Design

Figure 1 illustrates the experimental design used to assess the Pharmacy Management System's effectiveness in improving operational efficiency and accuracy.

Figure 1

Experimental design process



The design involves several stages:

Planning and definition: Establish the system's objectives, goals,

and overall scope.

Requirements gathering: Collect data from pharmacists, customers, and managers to identify key functionalities.

Prototype development: Construct a working prototype using software development tools such as UML diagrams to evaluate functionality and usability.

User testing and feedback: Conduct real-world testing and incorporate user feedback to refine the system.

System evaluation: Assess the system's accuracy, reliability, and scalability in operational settings, and report its impact on pharmacy operations and customer satisfaction.

Maintenance: Provide continuous technical support and implement periodic updates to meet evolving stakeholder requirements.

This experimental design ensures thorough testing, refinement, and optimization of the pharmacy management system.

Procedures of the Different Phases

The Agile methodology was employed for developing the pharmacy management system and online ordering system with data visualization due to its numerous advantages, including adaptability to changing requirements, responsiveness to feedback, early value delivery, risk reduction, enhanced collaboration, and transparency. Agile facilitates continuous development, enabling the system to evolve with user input and operational needs, thereby improving project success, customer satisfaction, and management efficiency.

The development process, following Agile methodology, involved iterative and cyclical stages:

Requirements: Engage stakeholders to gather, prioritize, and define

system needs and functionalities.

Design: Develop architectural and user interface designs using diagrams, illustrations, and prototypes to ensure alignment with stakeholder expectations.

Figure 2

Agile methodology



Development: Implement the system’s modules and components based on design specifications.

Testing: Conduct comprehensive testing, including unit, integration, and user acceptance tests, to verify functionality and compliance with requirements.

Deployment: Install and configure the system, migrate data, and launch the system in a live environment.

Review: Evaluate system performance post-deployment, gather feedback from end users and stakeholders, and identify areas for

improvement and future development.

The structured methodology ensures a robust, user-centered pharmacy management system that enhances efficiency, accuracy, and customer satisfaction.

Technical Framework

Materials

The development of the pharmacy management system utilized three primary resources: software, hardware, and data.

Software: The selected software components provide essential functionalities and ensure a seamless and user-friendly experience for both pharmacy administrators and customers.

Hardware: System performance and accessibility depend on the hardware used in the local development environment as well as the HostGator web server infrastructure hosting the application.

Data: The integration of various data types facilitates efficient inventory management, secure transactions, and comprehensive data analysis within the system.

These resources collectively support the development, deployment, and operational efficiency of the pharmacy management system.

Software

A variety of software components were utilized in the development of the Pharmacy Management System to ensure functionality, usability, and a positive user experience. Key software resources include:

Operating System: Windows 11 was used for local development and testing, while the live system operates on HostGator's web server

infrastructure.

Web Server Software: Apache HTTP Server version 2.4.48, deployed locally via XAMPP (which integrates Apache, MySQL, PHP, and other web development tools), and the Apache server provided by HostGator for online deployment.

Database Management: MySQL 8.0.21 served as the backend database for local development, while HostGator's MySQL server was used for live deployment.

Programming Languages: PHP (versions 7.4–8.0.7) and JavaScript were the primary languages. HTML and CSS were employed for front-end development, supporting dynamic and interactive functionality.

Development Environment: Visual Studio Code was used as the IDE, providing features such as code auto-completion, integrated debugging, and source control for efficient development.

Web Browsers: Google Chrome was the main testing target, with compatibility checks for Mozilla Firefox and Microsoft Edge.

Payment Gateway Integration: PayPal API was integrated for secure and reliable online transactions.

Security Software: Windows Defender Antivirus and Firewall secured the local environment, complemented by HostGator's web server security features for live deployment.

Data Visualization: Chart.js, a JavaScript framework, enabled interactive charts and graphs for sales, inventory, and other analytics.

Image Editing: Photoshop and Ibis Paint facilitated the customization and optimization of product images and graphical assets.

By leveraging this comprehensive suite of software tools, the development team ensured that the Pharmacy Management System supports efficient inventory management, online ordering, and data visualization

while maintaining security and compatibility with various platforms.

Hardware

The pharmacy management system relies on both local development hardware and HostGator web server infrastructure to ensure functionality, reliability, and accessibility.

Local Development Environment:

Computers: Desktop and laptop computers with Intel Core i5 processors, 8 GB RAM, and 512 GB SSD storage were used for system development and testing.

Mobile devices: Various smartphones and tablets were used to ensure responsive design and accessibility across platforms.

Printers: Standard printers facilitated printing invoices, reports, and labels.

HostGator Web Server Infrastructure:

Server: A shared hosting architecture managed CPU, RAM, and storage resources to host the system reliably.

Networking devices: Network switches and routers were managed by HostGator to ensure stable internal and external connectivity.

Storage devices: Shared storage arrays provided sufficient space for hosting multiple applications, including the Pharmacy Management System.

DNS servers: HostGator-managed DNS servers (ns8641.hostgator.com and ns8642.hostgator.com) enable domain name resolution and system accessibility.

Firewall: HostGator's shared hosting firewall monitors and filters network traffic to enhance system security.

The combination of local development hardware and HostGator's

hosting infrastructure ensured that the Pharmacy Management System is robust, scalable, and accessible, supporting seamless integration with the software components to deliver a reliable and user-friendly experience.

Table 1

Software, Hardware, and Data Tables of Materials Used

Category	Materials
Software	
Operating System	Windows 11
Web Server	Apache HTTP Server version 2.4.48
Database	MySQL 8.0.21
Programming Languages	PHP (versions 7.4 to 8.0.7), JavaScript
Text Editor/IDE	Visual Studio Code
Web Browser	Google Chrome
Payment Gateway	PayPal API
Security	Windows Defender Antivirus and Firewall
Data Visualization Tools	Chart.js
Photo Editor	Photoshop, Ibis Paint
Hardware	
Computers	Desktop and portable computers (Intel Core i5, 8GB RAM, 512GB SSD)
Mobile Devices	Smartphones, tablets
Printer	Standard printer
Web Server	HostGator shared server architecture
Networking Devices	Network switches, routers
Storage Devices	Hard drives, shared storage arrays
DNS Server	HostGator DNS servers (ns8641.hostgator.com, ns8642.hostgator.com)
Firewall	HostGator shared hosting firewall
Data	
Customer Records	Name, contact information, delivery address
Product Information	Name, description, price, stock quantity
Order Data	Order ID, customer ID, product ID, quantity, date, and time
Payment Information	Payment method, transaction ID, amount
Inventory Data	Stock levels reorder points, supplier information
Sales Data	Sales trends
User Accounts	Pharmacy administrators, customers

Modeling

The development of the pharmacy management system relied extensively on modeling, which provides a clear representation of the system's structure, behavior, and interconnections. During development, various modeling techniques were employed to capture and communicate the system's components effectively. These included use case diagrams, database design/schema and relationship tables, and data flow diagrams. By leveraging these modeling approaches, the system's features, database architecture, process flows, and overall behavior were clearly defined. The models ensured a shared understanding of the system architecture among stakeholders, improved communication between team members, and guided the development team throughout the implementation process. The following sections detail how these modeling techniques were applied in the development of the pharmacy management system.

USE Case

Figure 3 presents the administrator use case, showing how the system is managed by the admin. The administrator has full control and can perform essential functions such as viewing, recording, and updating product information, as well as managing customer records.

Figure 3

Admin use case



Figure 4

Customer use case

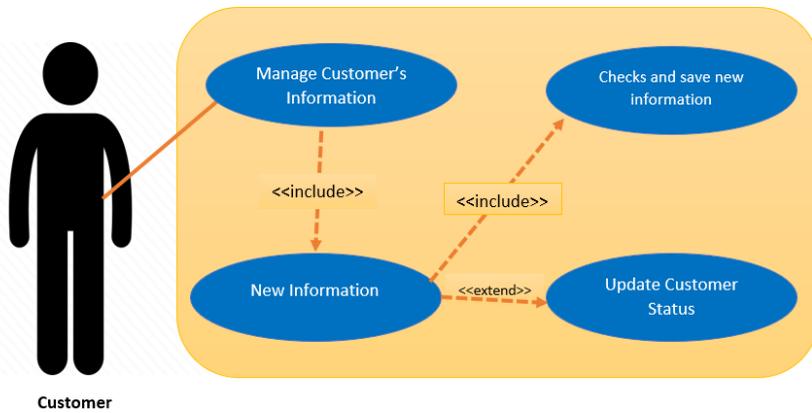
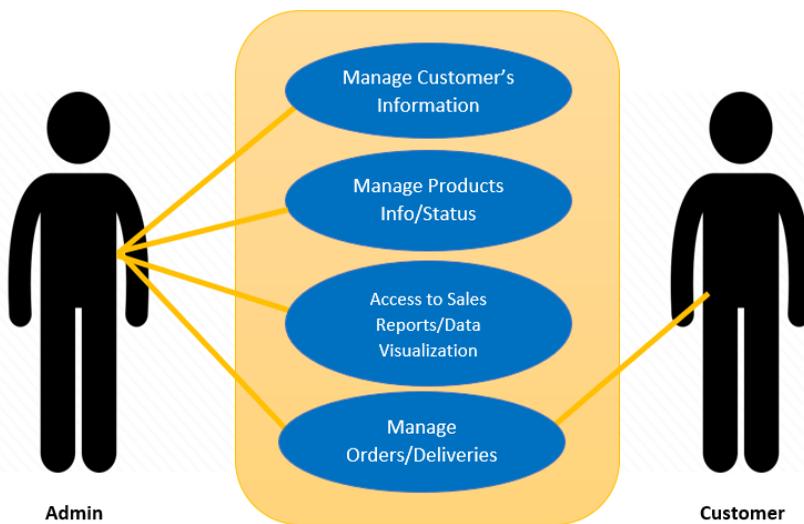


Figure 4 illustrates the system's overall operations and functionalities, which differ according to the actions performed by administrators, users, and customers.

Figure 5

Manage users' information



The primary focus of this use case is “Manage User Information.” It covers all functions and support required to efficiently handle and update user information within the system.

Figure 6

Manage orders

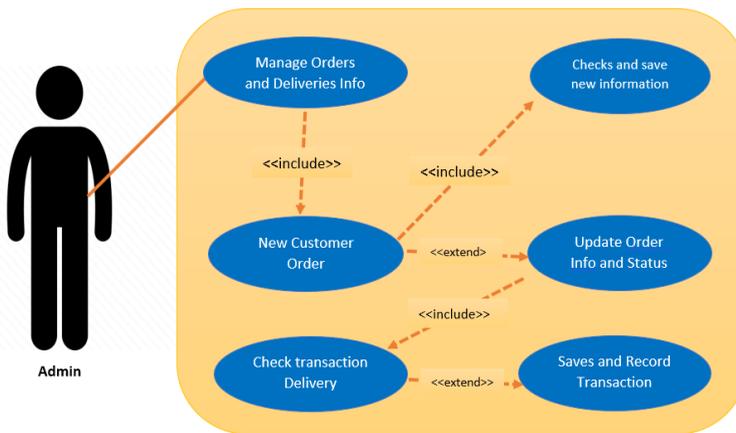


Figure 6 illustrates the data flow from customer requests and orders to final delivery. The tracked information includes the reservation or order date, item quantities, individual prices, total payment, and delivery status updates.

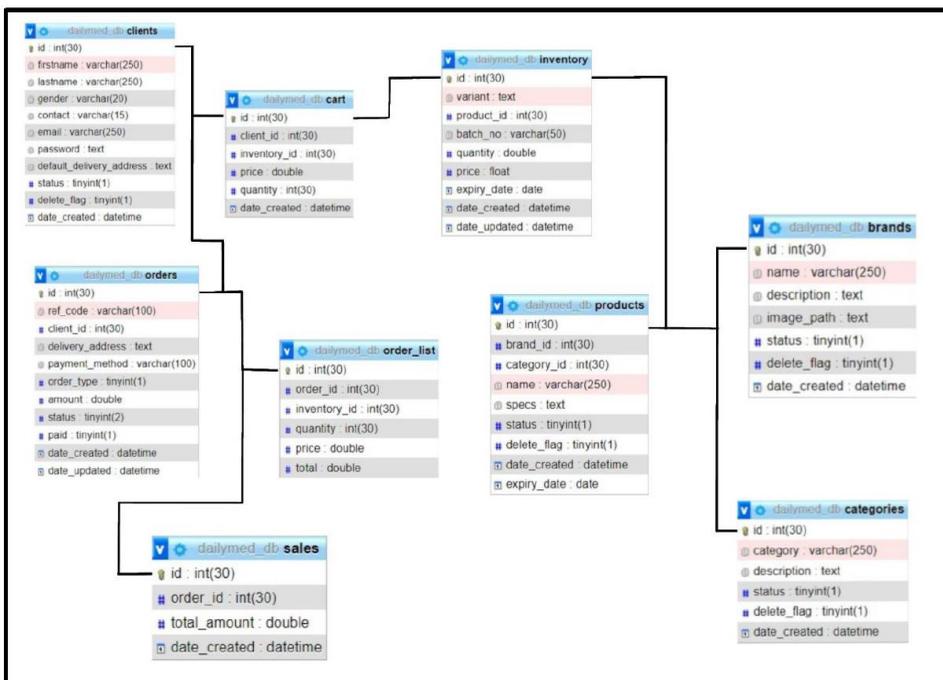
Database Design/ Schema and Relationship Table

Figure 7 illustrates the organization and interconnection of database tables through a schema and defined relationships. Entities such as Users, Customers, Orders, Order_List, Inventory, Sales, Products, Brands, and Categories are represented as tables within the sample database. Relationships are established using foreign keys; for instance, the Orders table may reference the Customers table to link each order to a specific customer. This structured approach streamlines data storage and retrieval,

ensuring information is efficiently organized and reliably managed. A well-designed database with clearly defined relationships strengthens system operations and facilitates seamless information access.

Figure 7

Database design/ schema and relationship



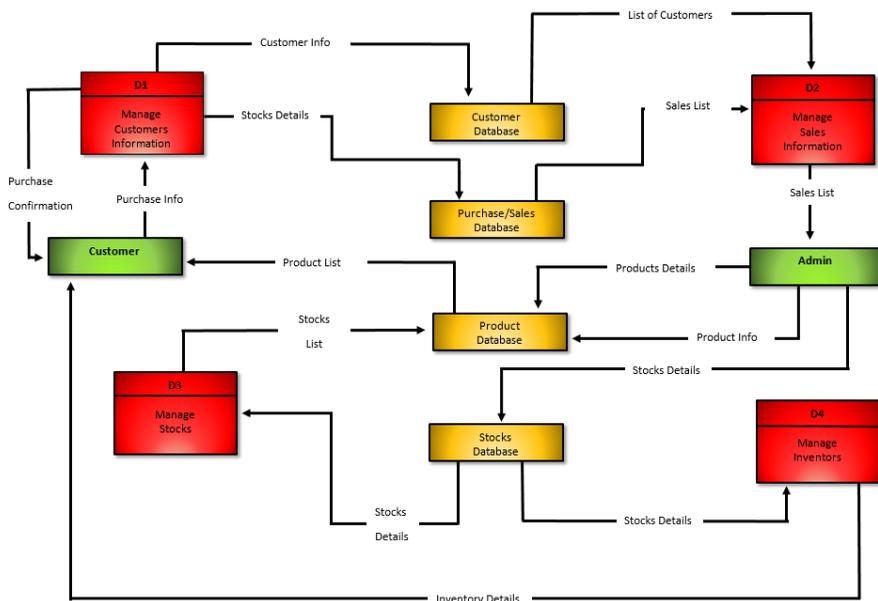
Data Flow Diagram

The Data Flow Diagram (DFD) in Figure 8 provides a visual representation that supports system understanding, analysis, and modeling. It illustrates how information flows and how different components of the Pharmacy Management System interact. The DFD shows the movement of data between major components and their associated databases. The Customer component manages customer information and purchase transactions, which are stored in the Customer Database and Purchase/Sales

Database. The Admin component oversees product information and stock levels, recorded in the Product Database and Inventory List. By mapping these data flows, the DFD highlights how the system enables efficient customer management, sales tracking, and inventory control.

Figure 8

Data flow diagram within system



System Design

This section presents the graphical user interface (GUI) design for system users, emphasizing visual elements, user interaction, responsiveness, and overall usability. The design is guided by the goal of providing an intuitive and efficient interface that meets the needs and preferences of system users.

New users can register using the “Customer Create Account” option by providing essential details such as their name, email, password, and

contact information, as shown in Figure 9. Once registered, they gain access to personalized features and services, including placing orders, viewing order histories, and securely managing personal data. This functionality ensures a seamless onboarding experience while enabling customers to interact with the system safely and efficiently.

Figure 9
Customer create account

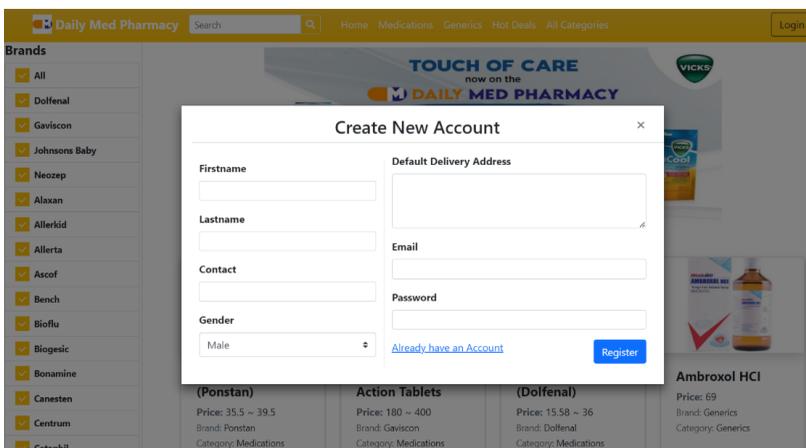
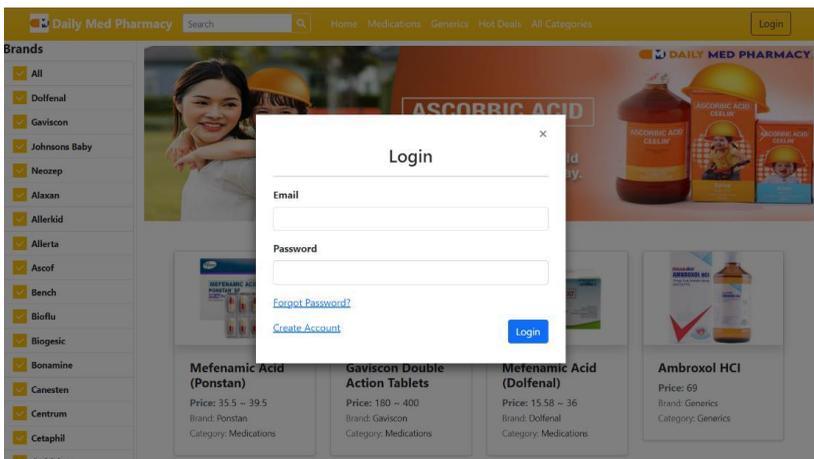


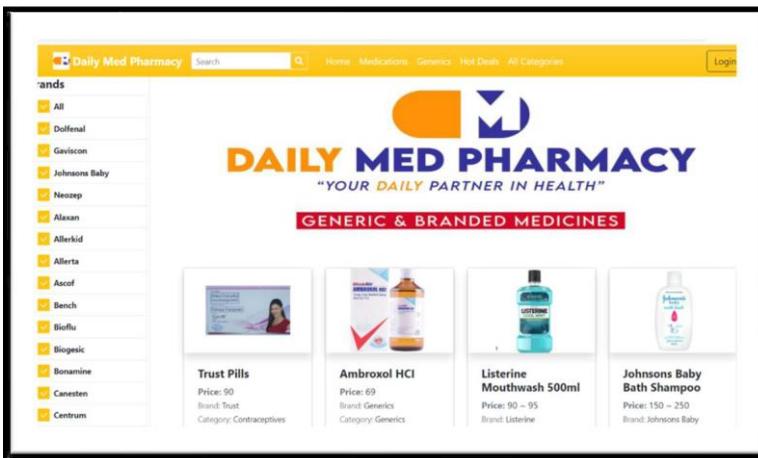
Figure 10
Customer log in



Registered users can securely access their accounts through the “Customer Login” option (Figure 10). By entering their credentials, such as a username and password, they can access personalized features, review purchase history, and manage account settings. This functionality ensures secure interaction with the system while allowing users to maintain full control over their data.

Figure 11

Homepage



Upon successful login, users are directed to the “Homepage,” which serves as the main interface of the system (Figure 11). The homepage provides a structured overview of available features and guides users in accessing them. Acting as a central hub, it enables seamless navigation to the various subsystems and modules of the Pharmacy Management System.

As illustrated in Figure 12, the “All Categories” option allows customers to browse and explore all available product categories. It presents a comprehensive list or menu, enabling users to view the full range of products offered by the system.

Figure 12

All categories

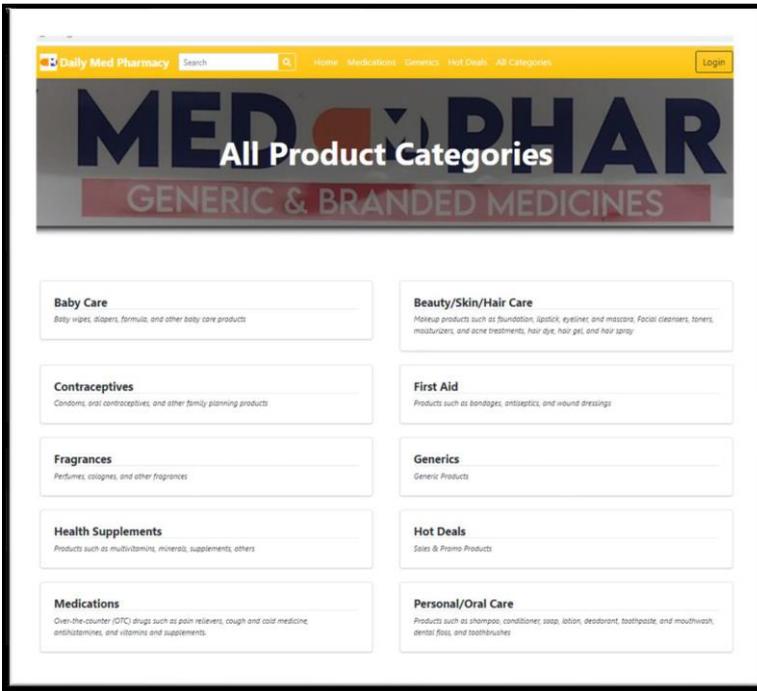
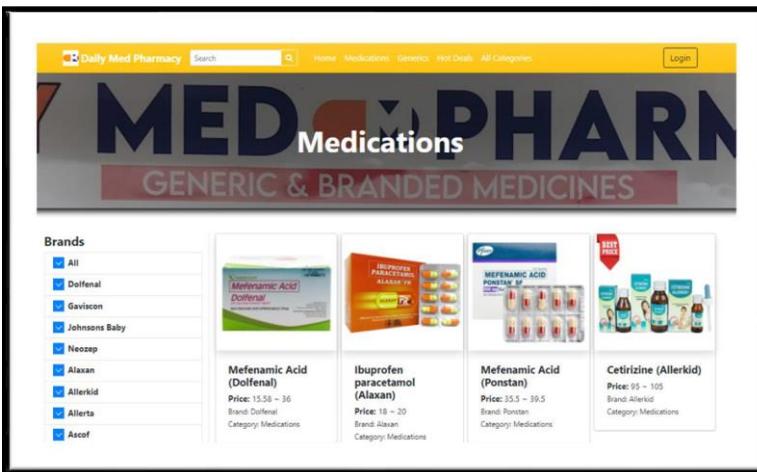


Figure 13

Medications category



The “Medications Category” is a subcategory that organizes pharmaceutical products, including over-the-counter (OTC) medications for a variety of treatments, as illustrated in Figure 13.

Figure 14

Add to cart

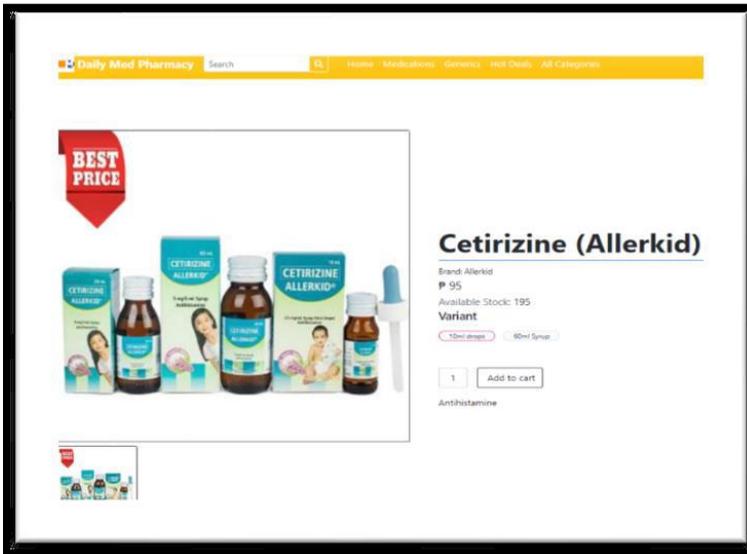
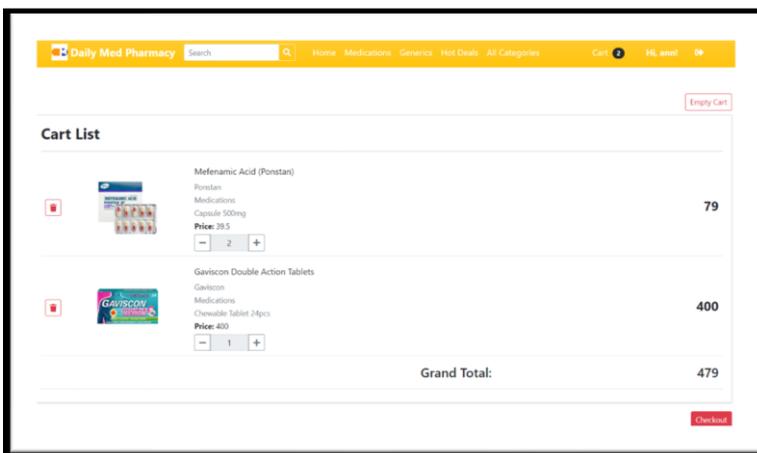


Figure 15

View cart list



As shown in Figure 14, when a user selects a product from a category, they can click the “Add to Cart” button to place the item in their virtual shopping cart. This feature allows customers to conveniently gather and organize their selected products before proceeding to checkout. Items remain in the cart while users continue browsing or make modifications to their selections. Meanwhile, the “View Cart List” option in Figure 15 provides customers with a clear summary of all items in their virtual shopping cart. It displays the selected products, their quantities, and prices, allowing users to review and verify their choices before proceeding to checkout.

Figure 16

Checkout

Checkout

Delivery Address

Your Address Here

Total: 479

Payment Method

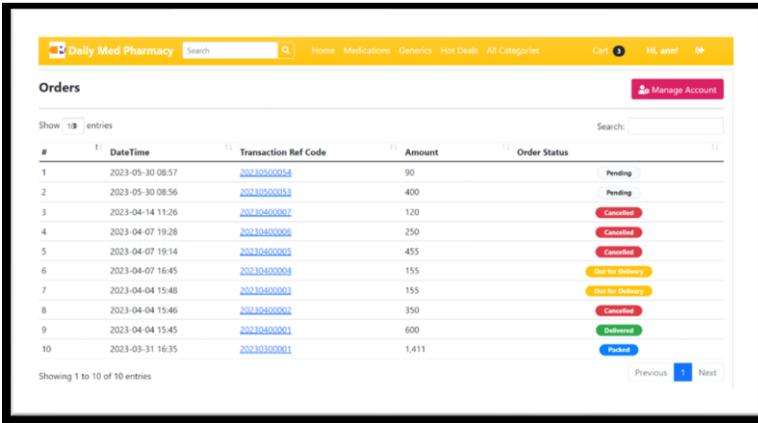
Cash on Delivery

PayPal Checkout
Shop now. Pay over time.

The “Checkout” feature in Figure 16 allows customers to complete their purchases by providing the necessary information and selecting a preferred payment method. Users can securely finalize their orders using either PayPal or Cash on Delivery (COD), ensuring a convenient transaction process.

Figure 17

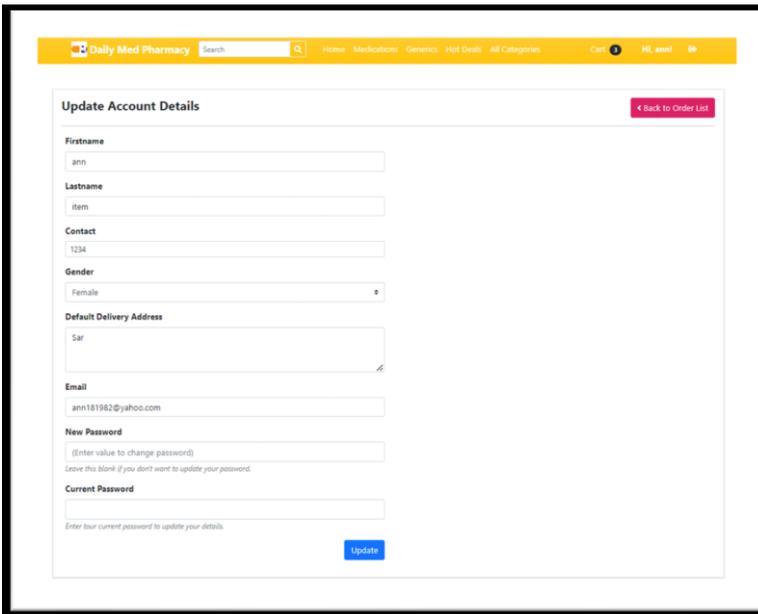
View order



The “View Orders” feature enables customers to access and review their past orders, facilitating the tracking of order history and monitoring of previous purchases.

Figure 18

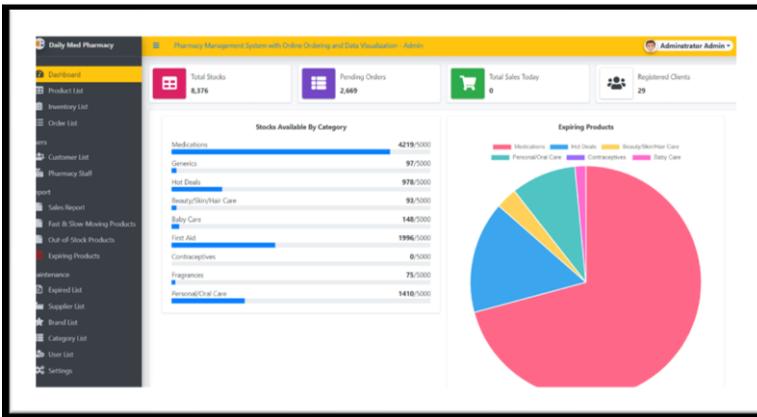
Manage account



The “Manage Account” feature allows users to update their personal account information, ensuring secure access and a personalized experience.

Figure 19

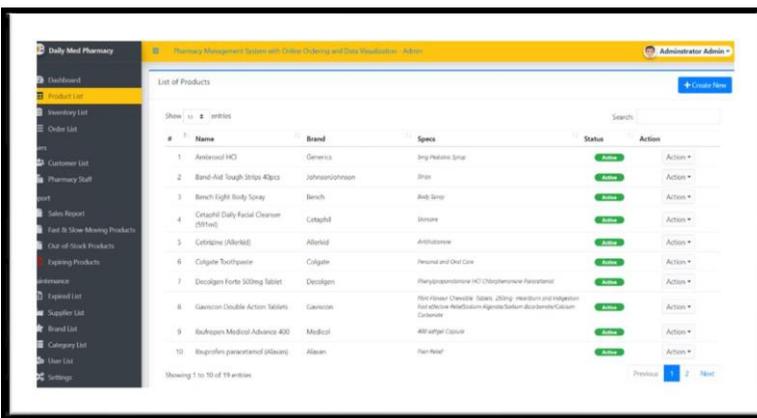
Admin dashboard



The “Admin Dashboard” serves as a centralized platform for pharmacy administrators, offering a comprehensive interface to efficiently monitor, manage, and oversee all pharmacy operations.

Figure 20

Product list

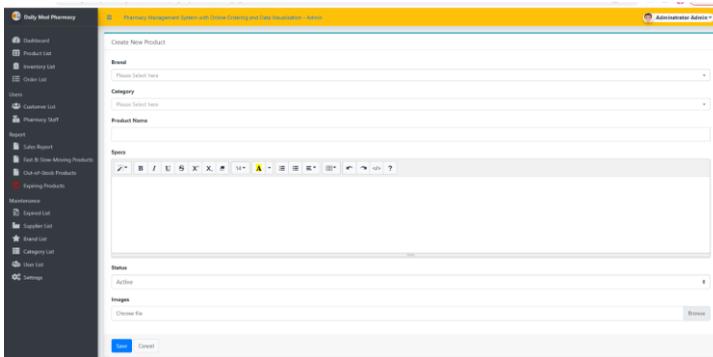


The “Product List” displays detailed information for all products in the system, including brand, name, and specifications. Administrators and

users can efficiently search and filter items by name, brand, or specifications, facilitating easier management and retrieval.

Figure 21

Create new product



The “Create New Product” feature allows pharmacy administrators to add new items to the system’s database, updating and expanding the product catalog. This ensures that all products are accurately recorded and readily accessible for both management and customer interactions.

Figure 22

Inventory list

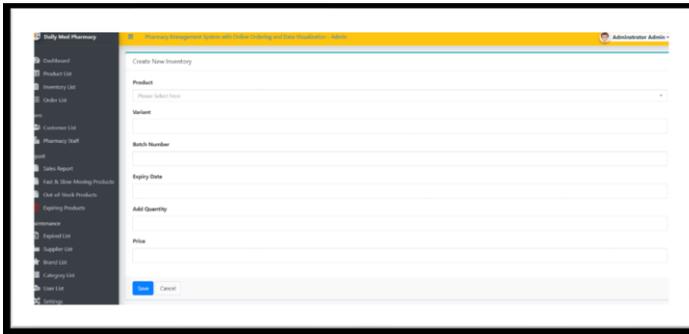
Product	Variant	Expiry Date	Batch Number	Price	Stock	Action
1 Benzyl Right Body Spray Brand: <i>Brand</i>	Spray 100 ml	2024-06-20	BR-101	100	64	Action
2 Round Aclid Tough Vaginal Ring Brand: <i>Brand</i>	Ring	2024-05-27	RA-102	90	592	Action
3 Aspirin HCl Brand: <i>Brand</i>	Syrup 100ml	2024-05-20	AS-103	100	84	Action
4 Celebrex (Celecoxib) Brand: <i>Brand</i>	Tablet	2024-05-10	AL-104	20	105	Action
5 Celebrex (Celecoxib) Brand: <i>Brand</i>	Oral Suspension	2024-05-20	AL-102	100	200	Action
6 Ibuprofen (Ibuprofen) Lethal Dose Brand: <i>Brand</i>	Oral Tablet	2024-05-30	AL-105	10	137	Action
7 Over-the-Counter (OTC) 20mg Capsule Brand: <i>Brand</i>	Tablet	2023-10-20	OTC-106	1.0	178	Action
8 Over-the-Counter (OTC) 20mg Capsule Brand: <i>Brand</i>	Capsule	2024-10-01	OTC-107	1.0	160	Action
9 Hydrocortisone Acetate 400 Brand: <i>Brand</i>	Oral Capsule	2023-05-30	HA-108	10.0	478	Action
10 Colgate Toothpaste Brand: <i>Brand</i>	Triple Action 200g	2024-10-23	CS-109	20	200	Action

The “Inventory List” feature provides a structured view of the pharmacy’s stock. For each product, it displays key details such as the name,

variation, expiry date, batch number, price, and available quantity. This functionality enables administrators to efficiently monitor and manage inventory levels.

Figure 23

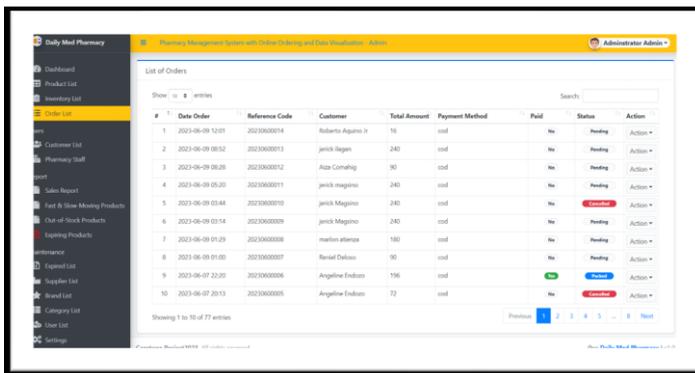
Create new inventory



The “Create New Inventory” function enables authorized users, such as pharmacy administrators or staff, to add new inventory records for products. This ensures the system maintains an accurate and up-to-date representation of product availability and stock levels.

Figure 24

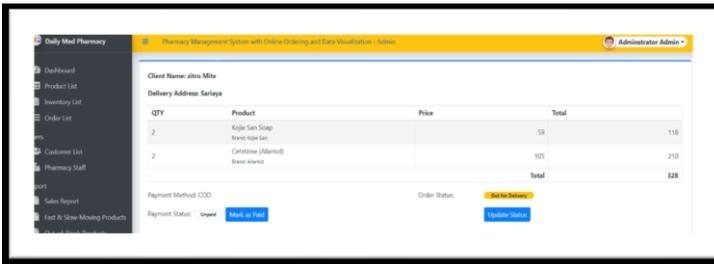
Order list



The “Order List” functionality provides a comprehensive overview of customer orders, enabling pharmacy administrators and staff to monitor and manage order statuses, ensuring a smooth and efficient order fulfillment process.

Figure 25

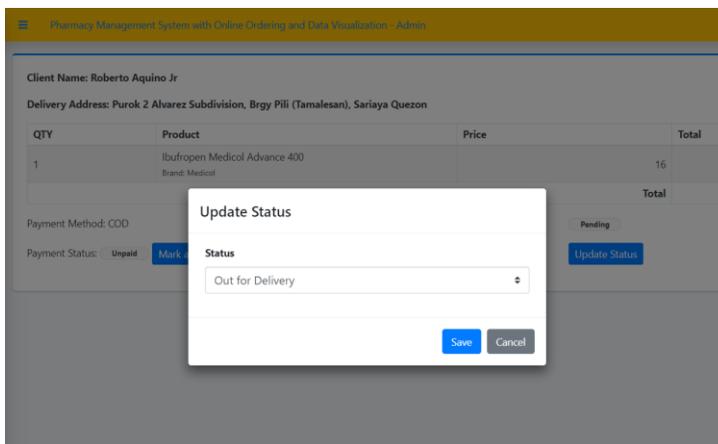
View customer’s order



The “View Customer’s Order” feature allows pharmacy administrators and staff to access and review specific order details. Beyond viewing standard order information, users can mark orders as paid and update their status, ensuring accurate tracking and efficient order management.

Figure 26

Update status



The “View Customer’s Order” feature enables administrators and staff to monitor and update order statuses as needed. Status options include Pending, Packed, Out for Delivery, Delivered, and Canceled. This functionality supports efficient order management while providing customers with clear, real-time updates, thereby enhancing satisfaction and communication.

Figure 27
Customer list

#	Date Created	Name	Email	Contact	Status	Action
1	2023-09-09 09:26	Alice Canahay	alicecanahay1997@gmail.com	09481120270	Active	Action *
2	2023-09-07 20:07	Angeline Endaco	angelinemebaco1996@gmail.com	09971361702	Active	Action *
3	2023-09-31 16:34	Ann Item	ann181982@yahoo.com	1234	Active	Action *
4	2023-09-07 02:08	Ann Item	anna@phoo.com	156899976	Active	Action *
5	2023-09-25 21:58	Ann Item	ann@sample.com	111111111111111	Active	Action *
6	2023-09-26 00:56	Anna Item	anna@sample.com	12345678	Active	Action *
7	2023-09-31 00:41	Anna Mei	mayamemey.cui@gmail.com	234567890	Active	Action *
8	2023-09-09 10:23	engene calling	engenecalling@gmail.com	09876123412	Active	Action *
9	2023-06-08 08:21	Jenaisa Magasin	jenaisamagasin7@gmail.com	09483972632	Active	Action *
10	2023-06-09 06:05	jenik itagen	jenikmagasin7@gmail.com	09123456677	Active	Action *

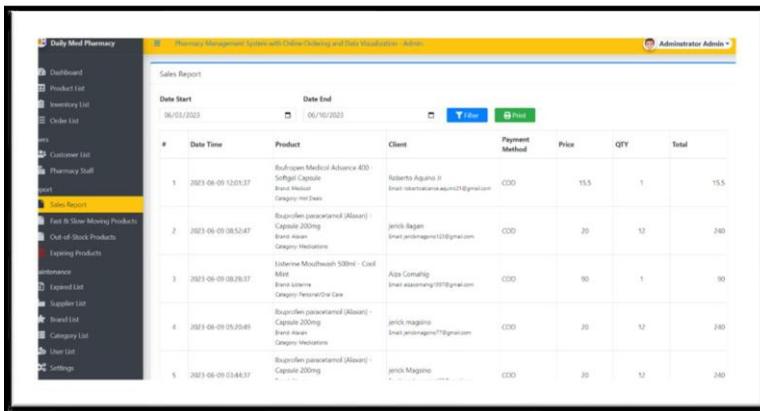
The “Customer List” feature displays a detailed record of all registered customers. It includes each customer’s name, contact information, and other relevant data, enabling administrators to manage customer information efficiently.

Figure 28
Pharmacy Staff

#	Product	Variant	Price	Stock	Action
1	Stash Eight Study	Syrup 100 ml	120	84	Quantity Add
2	Stash Eight Study	Syrup			Quantity Add
3	Stash Eight Study	Syrup 100 ml	90	1982	Quantity Add
4	Stash Eight Study	Syrup 100 ml	60	94	Quantity Add
5	Catrilaine (StashEight)	10ml drops	25	190	Quantity Add
6	Catrilaine (StashEight)	10ml Syrup	100	200	Quantity Add

The “Pharmacy Staff” feature allows administrators to manage walk-in orders, catering to customers who prefer purchasing medications in person rather than through the online system.

Figure 29
Sales report



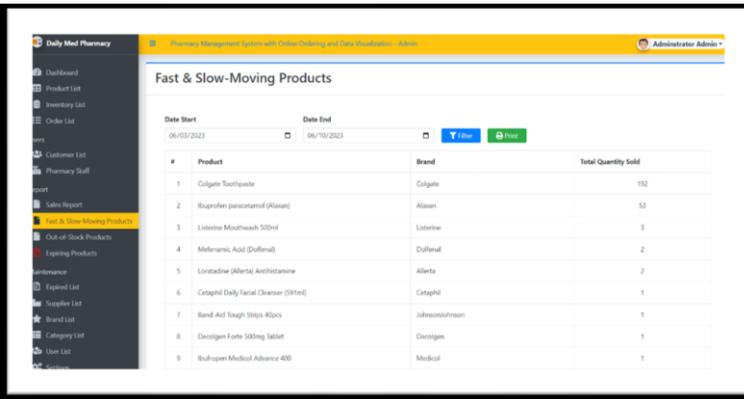
#	Date Time	Product	Client	Payment Method	Price	QTY	Total
1	2023-06-09 12:01:37	Buclupren Medical Advance 400 Softgel Capsule Brand: Mileon Category: Hot Deals	Roberto Aquino Jr Email: robertoquino.aquino2@gmail.com	COD	15.5	1	15.5
2	2023-06-09 08:52:47	Ibuprofen paracetamol (Mileon) Capsule 200mg Brand: Mileon Category: Medications	jenck Bagas Email: jenckbagas12@gmail.com	COD	20	12	240
3	2023-06-09 08:28:37	Esterline Mouthwash 500ml - Cool Mint Brand: Esterline Category: Personal Care	Aliza Comallig Email: alizacomallig2019@gmail.com	COD	90	1	90
4	2023-06-09 05:20:49	Ibuprofen paracetamol (Mileon) Capsule 200mg Brand: Mileon Category: Medications	jenck megasini Email: jenckmegasini7@gmail.com	COD	20	12	240
5	2023-06-09 03:48:37	Ibuprofen paracetamol (Mileon) Capsule 200mg	jenck Megasini	COD	20	12	240

The “Sales Report” feature generates detailed reports for a specified period, enabling users to analyze sales performance by date, product category, or customer segment. Reports can be printed or exported as PDFs for further analysis or sharing. This functionality supports data-driven decision-making, financial assessment, and overall business evaluation within the pharmacy.

The “Fast & Slow-Moving Products” feature in Figure 30 allows users to assess product sales based on turnover rates. It filters items by time periods, tracks sales, and identifies fast- and slow-moving products. Reports can be printed or exported for further analysis. This functionality supports informed decision-making related to inventory management, marketing strategies, stock levels, and areas for operational improvement.

Figure 30

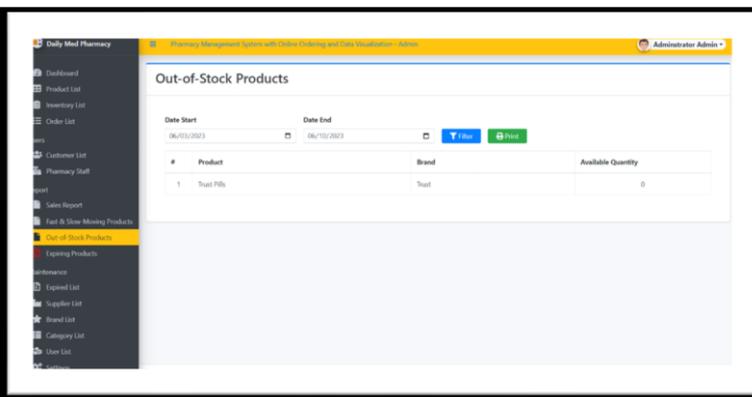
Fast and slow-moving product



#	Product	Brand	Total Quantity Sold
1	Colgate Toothpaste	Colgate	152
2	Ibuprofen paracetamol (Alaxan)	Alaxan	53
3	Listerine Mouthwash 500ml	Listerine	3
4	Mefenamic Acid (Difenal)	Difenal	2
5	Lorazepam (Alerta) Anesthetamine	Alerta	2
6	Cetaphil Daily Facial Cleanser (Cetfil)	Cetaphil	1
7	Band Aid Tough Strips 40pcs	Johnson&Johnson	1
8	Decolgen Forte 500mg Tablet	Decolgen	1
9	Bull-eyes Medical Advance 400	Medical	1

Figure 31

Out-of-stock products



#	Product	Brand	Available Quantity
1	Trust Pills	Trust	0

The “Out of Stock Products” feature in Figure 31 allows users to quickly identify items that are currently unavailable due to depleted inventory. This function helps pharmacy staff monitor stock levels and restock products as needed. By providing a clear and organized list of out-of-stock items, it supports efficient inventory management, ensuring customer needs are met while minimizing potential sales loss.

Figure 32

Expiring products

#	Product	Quantity	Brand	Category	Expiry Date	Batch Number	Action
1	Cetirizine (Alerkid)	198	Alerkid	Medications	2023-01-10	AL-101	Confirm
1	Loratadine (Alertra) Antihistamine	169	Alertra	Medications	2023-02-20	AL-103	Confirm
1	Bupropion Medical Advance 400	409	Medical	Hot Deals	2023-01-30	ME-101	Confirm
1	Cetaphil Daily Facial Cleanser (S914e)	93	Cetaphil	Beauty/Skin/Hair Care	2023-03-30	CE-101	Confirm
1	Listerine Mouthwash 500ml	200	Listerine	Personal/Oral Care	2022-12-31	LIS-101	Confirm
1	Listerine Mouthwash 500ml	86	Listerine	Personal/Oral Care	2023-04-30	LIS-102	Confirm
1	Mefenamic Acid (Ponstan)	498	Ponstan	Medications	2023-03-20	PO-101	Confirm
1	Trust Pills	0	Trust	Contraceptives	2023-03-26	TR-101	Confirm
1	Johnson's Baby Bath Shampoo	48	Johnson's Baby	Baby Care	2023-01-10	MR-101	Confirm

The “Expiring Products” feature allows users to quickly identify and manage items nearing their expiration dates. This tool helps pharmacists stay organized and proactively ensure product quality and patient safety. By providing a list of expiring items along with a confirmation function, it simplifies expiry tracking and verification. Pharmacies can efficiently remove outdated products and implement timely disposal procedures, reducing risks and maintaining regulatory compliance.

Figure 33

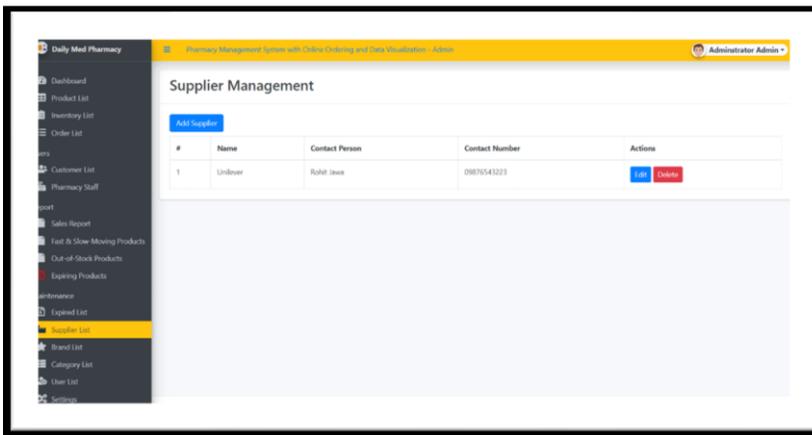
Expired list

#	Product	Quantity	Brand	Category	Expiry Date	Batch Number	Action
1	Listerine Mouthwash 500ml	86	Listerine	Personal/Oral Care	2023-04-30	LIS-102	—
2	Cetaphil Daily Facial Cleanser (S914e)	93	Cetaphil	Beauty/Skin/Hair Care	2023-03-30	CE-101	—
3	Trust Pills	0	Trust	Contraceptives	2023-03-26	TR-101	—
4	Mefenamic Acid (Ponstan)	498	Ponstan	Medications	2023-03-20	PO-101	—
5	Ibuprofen paracetamol (Alean)	116	Alean	Medications	2023-02-26	ALA-102	—
6	Loratadine (Alertra) Antihistamine	169	Alertra	Medications	2023-02-20	AL-103	—
7	Bupropion Medical Advance 400	409	Medical	Hot Deals	2023-01-30	ME-101	—
8	Johnson's Baby Bath Shampoo	48	Johnson's Baby	Baby Care	2023-01-10	MR-101	—
9	Cetirizine (Alerkid)	198	Alerkid	Medications	2023-01-10	AL-101	—
10	Listerine Mouthwash 500ml	200	Listerine	Personal/Oral Care	2022-12-31	LIS-101	—
11	Mefenamic Acid (Dolfinal)	243	Dolfinal	Medications	2022-10-30	DOX-102	—

The “Expired List” feature enables pharmacies to efficiently manage products that have passed their expiration dates. It organizes expired items by name, quantity, and expiry date, allowing for quick identification. Pharmacies can then remove these products from shelves, dispose of them properly, or process returns and reimbursements as needed. This functionality ensures product quality, regulatory compliance, and the safe and effective use of medications by customers.

Figure 34

Supplier list



The “Supplier List” feature in the Pharmacy Management System enables pharmacies to maintain a centralized record of their suppliers. It provides essential details for each supplier, including contact information, allowing efficient management of supplier relationships. While it does not support online ordering, this feature is a valuable tool for monitoring supplier information, ensuring effective communication, and supporting informed decision-making in inventory procurement.

The “Brand List” feature (Figure 35) provides concise information about each drug brand. It allows pharmacy staff and customers to quickly

access details about brands and their associated medications. This functionality supports accurate dispensing and efficient inventory management by enabling the identification and selection of specific brands. Maintaining an up-to-date brand list helps the pharmacy meet customer needs and provide comprehensive drug information.

Figure 35
Brand list

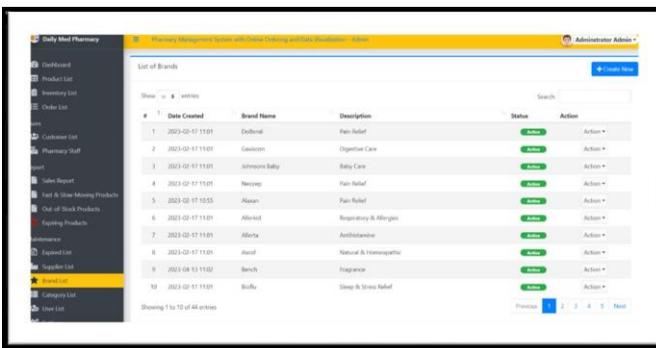
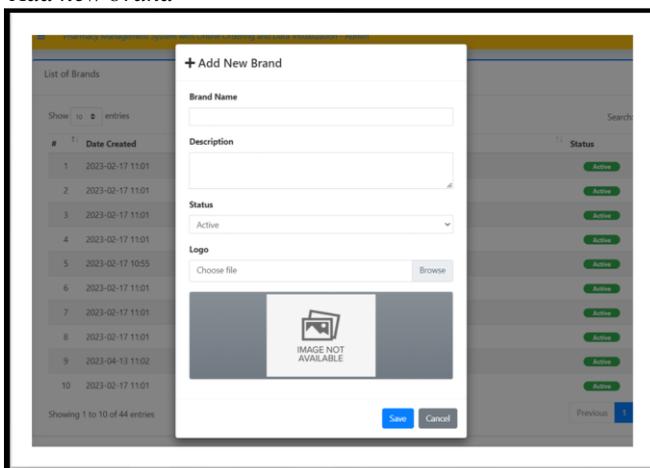


Figure 36
Add new brand



The “Add New Brand” feature allows pharmacists to add new drug brands to the system. Users can input brand names and relevant details,

ensuring the database remains current for accurate medication identification and inventory management. This functionality enhances the pharmacy’s product variety and supports improved customer service.

The “Category List” feature (Figure 37) displays the pharmacy’s therapeutic classifications and drug categories. It enables pharmacists and customers to quickly locate medications by category, streamlining retrieval and distribution. Maintaining an organized category list enhances inventory management, facilitates efficient medicine selection, and improves satisfaction for both staff and customers.

Figure 37
Category list

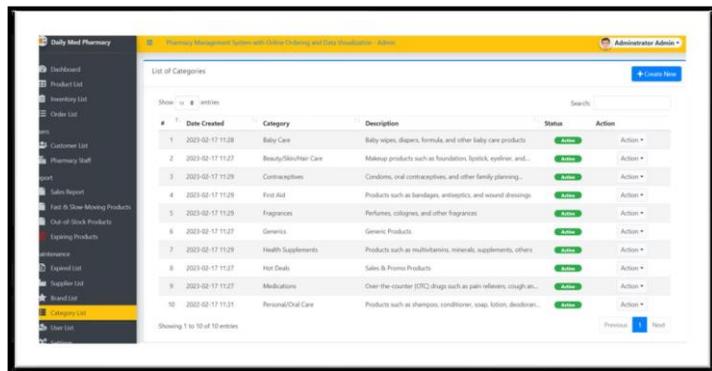
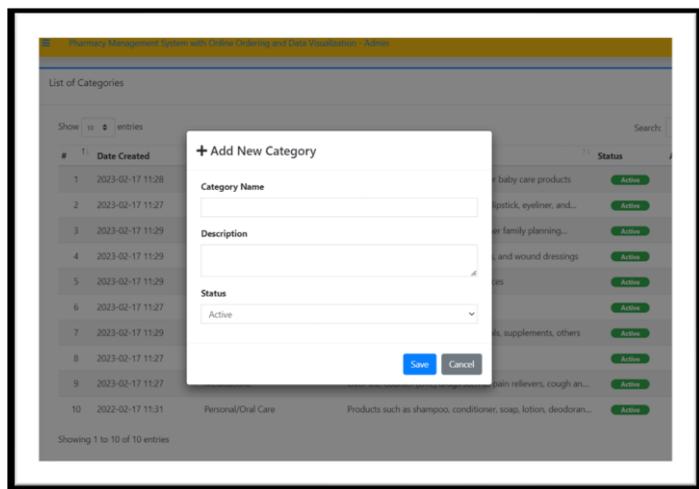


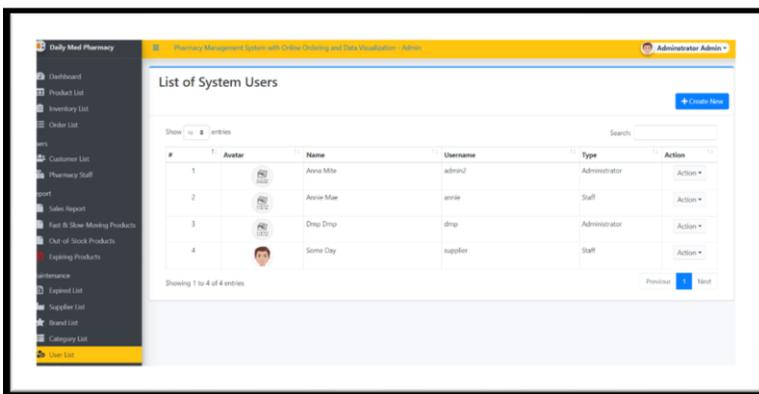
Figure 38
Add New Category



The “Add New Category” feature (Figure 38) of the Pharmacy Management System allows pharmacists to create new pharmaceutical categories or therapeutic classes. Staff can organize medications within the system by specifying the category name and description. This functionality enhances the efficiency of drug selection for both staff and customers. By expanding the category list, the pharmacy can better respond to changing medicine inventories and offer a wider range of options to clients.

Figure 39

User list



The “User List” feature displays all registered users, assisting administrators and staff in managing user accounts. It provides essential information such as username, email, role, and contact details. Administrators can create, update, activate, deactivate, and reset user passwords directly from the User List. This functionality ensures secure and effective management of accounts and access control within the Pharmacy Management System.

System Evaluation and Testing

User feedback and evaluations were collected from 20 participants, including 5 IT specialists, 3 pharmacy owners, and 12 customers. The

evaluation aimed to assess system effectiveness, usability, and overall user satisfaction. Questionnaires were designed based on ISO 25010, the standard for software product quality. Responses were analyzed using the weighted mean formula, calculating an overall score for each quality characteristic while considering the assigned weight of each criterion.

Figure 40 shows that the pharmacy management system was well-received by participants. It demonstrated strong performance across functionality, efficiency, compatibility, usability, reliability, maintainability, security, and portability. The system’s stable, secure, and user-friendly design aligns with user needs.

Figure 40

Summary of evaluation of the developed system



Average ratings indicate that most respondents either agreed or strongly agreed with the system’s features and capabilities. Overall, the system is well-designed, efficient, and suitable for varied contexts. It is user-friendly, dependable, secure, and easy to maintain. Areas for improvement include performance efficiency and security, where average ratings suggested agreement rather than strong agreement. These results

indicate that the system fulfills its intended purpose and provides useful insights for further enhancements.

Compatibility: Respondents agreed or strongly agreed that the system is compatible with multiple platforms, operating systems, and software components. The average score of 4.21 demonstrates high compatibility, indicating seamless integration with various technologies and consistent user experience across environments.

Usability: Most respondents agreed or strongly agreed that the system is easy to learn and use. With an average usability score of 4.22, the system is considered highly usable. Intuitive navigation and simple features enable users to maximize system benefits and promote a positive experience.

Reliability: Respondents indicated that the system is reliable, functioning without errors or downtime. An average score of 4.32 confirms high reliability. The system handles data accurately, processes transactions correctly, and maintains consistent performance, instilling user confidence.

Security: Respondents agreed that the system provides adequate security to protect sensitive data. The average security score of 4.16 suggests room for improvement. This evaluation highlights potential areas to strengthen system and data security.

Maintainability: Most respondents agreed or strongly agreed that the system is easy to update, enhance, and fix. With an average score of 4.23, the system's modular code, clear documentation, and design flexibility support effective maintenance, ensuring long-term viability.

Portability: Respondents agreed or strongly agreed that the system is adaptable across platforms. With a portability score of 4.17, the system demonstrates compatibility with multiple devices and operating systems, ensuring mobility and accessibility.

Economic feasibility was evaluated by analyzing costs and benefits of system implementation:

Costs: Development, hardware and software procurement, training, and ongoing maintenance were carefully estimated.

Benefits: Increased operational efficiency, streamlined processes, improved data accuracy, reduced documentation, and enhanced customer satisfaction were quantified.

Additional considerations included market demand, competitive advantage, and strategic alignment. The analysis concluded that implementation is economically feasible, with anticipated benefits exceeding costs and providing a positive return on investment.

Technology feasibility assessed whether the proposed technological infrastructure could support system implementation, considering:

Compatibility: Integration with existing hardware, software, and network infrastructure.

Availability: Access to required servers, databases, frameworks, and development tools within the desired timeframe.

Suitability: Ability of the technology to meet performance, scalability, security, and support requirements.

The evaluation confirmed that the proposed technology stack is viable and capable of supporting the system's functionality, performance, and long-term sustainability.

Operational feasibility examined whether the system could integrate smoothly with existing processes and workflows. Key factors included infrastructure compatibility, availability of resources, and impact on daily operations. The analysis confirmed that the system can be successfully implemented without significant disruption to organizational activities.

Conclusion

The web-based pharmacy management system with online ordering and data visualization has achieved its objectives. The system's positive attributes demonstrate its effectiveness in meeting the expectations of both the pharmacy owner/manager and customers. While security enhancements are recommended, the overall evaluation confirms the system is a robust, efficient, and practical solution for modern pharmacy management.

Bibliography

- Adeodu, A., Maladzhi, R., Katumba, M. G. K., & Daniyan, I. (2023). Development of an improvement framework for warehouse processes using Lean Six Sigma (DMAIC) approach: A case of third party logistics (3PL) services. *Heliyon*, 9(4), e14915. <https://doi.org/10.1016/j.heliyon.2023.e14915>
- Ahmed, I., Feng, B., Yeboah, K. E., Feng, J., Jumani, M. S., & Ali, S. A. (2024). Leveraging Industry 4.0 for marketing strategies in the medical device industry of emerging economies. *Scientific Reports*, 14(1), 27664. <https://doi.org/10.1038/s41598-024-78521-0>
- Alanazi, M. F., Shahein, M. I., Alsharif, H. M., Alotaibi, S. M., Alanazi, A. O., Alanazi, A. O., Alharbe, U. A., Almfalh, H. S. S., Amirthalingam, P., Hamdan, A. M., Veeramani, V. P., Mohamed, S. H. P., & Ali, M. A. S. (2022). Impact of automated drug dispensing system on patient safety. *Pharmacy Practice*, 20(4), 2744. <https://doi.org/10.18549/PharmPract.2022.4.2744>
- Alhuwail, D., Al-Jafar, E., Abdulsalam, Y., & AlDuaij, S. (2021). Information security awareness and behaviors of health care professionals at public health care facilities. *Applied Clinical Informatics*, 12(4), 924–932. <https://doi.org/10.1055/s-0041-1735527>
- Almeman, A. (2024). The digital transformation in pharmacy: Embracing online platforms and the cosmeceutical paradigm shift. *Journal of Health, Population and Nutrition*, 43(1), 60. <https://doi.org/10.1186/s41043-024-00550-2>
- Babel, A., Taneja, R., Mondello Malvestiti, F., Monaco, A., & Donde, S. (2021). Artificial intelligence solutions to increase medication adherence in patients with non-communicable diseases. *Frontiers in Digital Health*, 3, 669869. <https://doi.org/10.3389/fdgth.2021.669869>
- Bahamdan, A. K., & Almanasef, M. (2024). A cross-sectional study assessing customers' perception, satisfaction, and attitude toward e-pharmacy services in Saudi Arabia. *BMC Health Services Research*, 24, 1659. <https://doi.org/10.1186/s12913-024-12174-7>
- Bialas, C., Revanoglou, A., & Manthou, V. (2020). Improving hospital pharmacy inventory management using data segmentation. *American Journal of Health-System Pharmacy*, 77(5), 371–377. <https://doi.org/10.1093/ajhp/zxz264>
- Dopp, A. R., Parisi, K. E., Munson, S. A., et al. (2020). Aligning implementation and user-centered design strategies to enhance the

- impact of health services: Results from a concept mapping study. *Implementation Science Communications*, 1, 17. <https://doi.org/10.1186/s43058-020-00020-w>
- Eberhard, K. (2023). The effects of visualization on judgment and decision-making: A systematic literature review. *Management Review Quarterly*, 73, 167–214. <https://doi.org/10.1007/s11301-021-00235-8>
- Ezeamii, V. C., Okobi, O. E., Wambai-Sani, H., Perera, G. S., Zaynieva, S., Okonkwo, C. C., Ohaiba, M. M., William-Enemali, P. C., Obodo, O. R., & Obiefuna, N. G. (2024). Revolutionizing healthcare: How telemedicine is improving patient outcomes and expanding access to care. *Cureus*, 16(7), e63881. <https://doi.org/10.7759/cureus.63881>
- Fatorachian, H., & Pawar, K. (2025). Sustainable cold chain management: An evaluation of predictive waste management models. *Applied Sciences*, 15(2), 770. <https://doi.org/10.3390/app15020770>
- Folorunso, A., Wada, I., Samuel, B., & Mohammed, V. (2024). Security compliance and its implication for cybersecurity. *World Journal of Advanced Research and Reviews*, 24(1), 2105–2121. <https://doi.org/10.30574/wjarr.2024.24.1.3170>
- Hamad, M. M. E., & Bah, S. (2022). Impact of implementing electronic health records on medication safety at a HIMSS Stage 6 hospital: The pharmacist's perspective. *Canadian Journal of Hospital Pharmacy*, 75(4), 267–275. <https://doi.org/10.4212/cjhp.3223>
- Houcheimi, A., & Mezei, J. (2024). The role of secure online payments in enabling the development of e-tailing. *Journal of Organizational Computing and Electronic Commerce*, 34(4), 299–317. <https://doi.org/10.1080/10919392.2024.2371236>
- Javanmardi, E., Maresova, P., Xie, N., & Mierzwiak, R. (2024). Exploring business models for managing uncertainty in healthcare, medical devices, and biotechnology industries. *Heliyon*, 10(4), e25962. <https://doi.org/10.1016/j.heliyon.2024.e25962>
- Khare, P. S. (2025). Telepharmacy in hospital pharmacy: Implementation, challenges, and future directions. *Intelligent Hospital*. Advance online publication. <https://doi.org/10.1016/j.inhs.2025.100025>
- Khedr, A. M., & Rani, S. S. (2024). Enhancing supply chain management with deep learning and machine learning techniques: A review. *Journal of Open Innovation: Technology, Market, and Complexity*, 10(4), 100379. <https://doi.org/10.1016/j.joitmc.2024.100379>
- Kroenert, A. C., & Bertsche, T. (2024). Implementation, barriers, solving strategies and future perspectives of reimbursed community

- pharmacy services: A nationwide survey for community pharmacies in Germany. *BMC Health Services Research*, 24(1), 1463. <https://doi.org/10.1186/s12913-024-11745-y>
- Kumar, K. P., Prathap, B. R., Thiruthuvanathan, M. M., Murthy, H., & Pillai, V. J. (2024). Secure approach to sharing digitized medical data in a cloud environment. *Data Science and Management*, 7(2), 108–118. <https://doi.org/10.1016/j.dsm.2023.12.001>
- Kuzma, J. (2011). Web vulnerability study of online pharmacy sites. *Informatics for Health and Social Care*, 36(1), 20–34. <https://doi.org/10.3109/17538157.2010.520418>
- Martínez-Peláez, R., Ochoa-Brust, A., Rivera, S., Félix, V. G., Ostos, R., Brito, H., Félix, R. A., & Mena, L. J. (2023). Role of digital transformation for achieving sustainability: Mediated role of stakeholders, key capabilities, and technology. *Sustainability*, 15(14), 11221. <https://doi.org/10.3390/su151411221>
- Mason, M., Cho, Y., Rayo, J., Gong, Y., Harris, M., & Jiang, Y. (2022). Technologies for medication adherence monitoring and technology assessment criteria: Narrative review. *JMIR mHealth and uHealth*, 10(3), e35157. <https://doi.org/10.2196/35157>
- Noor, A. (2022). Adoption of blockchain technology facilitates a competitive edge for logistic service providers. *Sustainability*, 14(23), 15543. <https://doi.org/10.3390/su142315543>
- Pabba, S. K., Verma, A., Nikitas, A., & Haloub, R. (2025). Supply chain management for online pharmacies: An exploration of operations, pricing, counterfeit medicine and technology uptake. *Sustainable Futures*, 10, 101294. <https://doi.org/10.1016/j.sfr.2025.101294>
- Pancić, M., Čučić, D., & Serdarušić, H. (2023). Business intelligence (BI) in firm performance: Role of big data analytics and blockchain technology. *Economies*, 11(3), 99. <https://doi.org/10.3390/economies11030099>
- Peng, Y., Wang, H., Fang, Q., Xie, L., Shu, L., Sun, W., & Liu, Q. (2020). Effectiveness of mobile applications on medication adherence in adults with chronic diseases: A systematic review and meta-analysis. *Journal of Managed Care & Specialty Pharmacy*, 26(4), 550–561. <https://doi.org/10.18553/jmcp.2020.26.4.550>
- Pisoni, G., Molnár, B., & Tarcsi, Á. (2024). Knowledge management and data analysis techniques for data-driven financial companies. *Journal of the Knowledge Economy*, 15, 13374–13393. <https://doi.org/10.1007/s13132-023-01607-z>
- Porterfield, A., Engelbert, K., & Coustasse, A. (2014). Electronic prescribing: Improving the efficiency and accuracy of prescribing in

- the ambulatory care setting. *Perspectives in Health Information Management*, 11(Spring), 1g.
- Rahman, M. A., & Kirby, E. D. (2024). The Lean advantage: Transforming e-commerce warehouse operations for competitive success. *Logistics*, 8(4), 129. <https://doi.org/10.3390/logistics8040129>
- Rosário, A. T., & Dias, J. C. (2023). How has data-driven marketing evolved: Challenges and opportunities with emerging technologies. *International Journal of Information Management Data Insights*, 3(2), 100203. <https://doi.org/10.1016/j.jjimei.2023.100203>
- Salime, G. M., Bhirich, N., Chefchaoui, A. C., Hamdaoui, O. E., Baraka, S. E., & Elalaoui, Y. (2025). Assessment of automation models in hospital pharmacy: Systematic review of technologies, practices, and clinical impacts. *Hospital Pharmacy*. Advance online publication. <https://doi.org/10.1177/00185787251315622>
- Shahmoradi, L., Safdari, R., Ahmadi, H., & Zahmatkeshan, M. (2021). Clinical decision support systems-based interventions to improve medication outcomes: A systematic literature review on features and effects. *Medical Journal of the Islamic Republic of Iran*, 35, 27. <https://doi.org/10.47176/mjiri.35.27>
- Silberglitt, R., & Antón, A. (2020). Advances in medical technology. In *The Global Technology Revolution 2020: Bio/Nano/Materials/Information Trends, Drivers, Barriers, and Social Implications* (pp. 65–82). RAND Corporation.
- Staras, S., Tauscher, J., Rich, N., Samarah, E., Thompson, L., Vinson, M., Muszynski, M., & Shenkman, E. (2021). Using a clinical workflow analysis to enhance eHealth implementation planning: Tutorial and case study. *JMIR mHealth and uHealth*, 9(3), e18534. <https://doi.org/10.2196/18534>
- Varghese Assin, T. J., George, N. A., Aboobaker, N., & Sivakumar, P. (2025). Emerging market dynamics: Risk perceptions, perceived usefulness and e-pharmacy adoption. *International Journal of Pharmaceutical and Healthcare Marketing*, 19(1), 139–159. <https://doi.org/10.1108/IJPHM-11-2023-0101>
- Zacharia, A., Thomas, A. C., Mathew, P. C., Cleetus, R. S., John, S. E., & Joseph, J. (2024). Exploring the intersection of e-commerce and healthcare: A visual analysis of research trends. *Cureus*, 16(9), e69865. <https://doi.org/10.7759/cureus.69865>