Department of Computer Information Sciences and Mathematics

In Partial Fulfillment of the Requirements of

CIS 2105 - Networking II

Better Outcomes, Gifted Oath Hospital Network Plan

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Chapter I: Introduction

Hospitals in the Philippines face increasing challenges due to the growing demand for healthcare services, exacerbated by the pandemic and rapid urbanization. Robust and efficient network plans are essential to address these challenges, as modern healthcare systems heavily rely on digital solutions for patient records, telemedicine, and diagnostic tools.

In 2024, the Philippine government allocated PHP 22.98 billion ($404.1 million) to enhance healthcare facilities, focusing on improving infrastructure in disadvantaged areas and supporting Universal Health Care goals. However, many hospitals, especially in rural areas, struggle with outdated technology and inadequate network setups, hampering efficient service delivery. For instance, less than 1 hospital bed per 1,000 residents highlights the strain on facilities.

Private hospitals have invested in modernizing equipment and infrastructure, but the gap in public healthcare, where most citizens depend, underscores the urgent need for better connectivity. Optimized network systems can improve electronic health record management, enable telemedicine in remote areas, and reduce reliance on centralized, overwhelmed facilities. Such upgrades are critical to bridging gaps in care delivery and ensuring equitable health services across the country.

The Better Outcomes Gifted Oath Hospital (BOGOH) is set to lead the way in implementing a modern IP telephony system in the Philippines. This initiative aligns with the increasing need for hospitals to adopt advanced network solutions to improve operational efficiency and patient care. The new system aims to streamline communication within the hospital and enhance telemedicine capabilities, ensuring better coordination across departments and with remote healthcare providers.

This move complements the Philippine government's significant investment in healthcare infrastructure, as exemplified by the PHP 22.98 billion budget for 2024, which focuses on modernizing facilities and expanding services in underserved areas.

The BOGOH initiative highlights how private institutions can complement public healthcare efforts, demonstrating leadership in adopting cutting-edge technologies to meet the demands of modern healthcare systems.

Chapter II: Related Literature

The integration of information technology in hospital management systems is paramount for enhancing operational efficiency and patient care. Fenska Seipalla et al. (2023) emphasize the significance of understanding network topology in hospital management, noting that the choice of network infrastructure directly impacts the hospital's operational goals and objectives. The study provides a comprehensive overview of various network topologies, highlighting their advantages and disadvantages in the context of hospital management systems.

2.1 Network Topologies in Hospital Management

2.1.1 Bus Topology

This topology is cost-effective and easy to implement, making it suitable for small networks. However, it is vulnerable to disruptions if any segment of the cable fails, which can impede data transmission (Seipalla et al., 2023).

2.1.2 Star Topology

This is the most commonly used topology in hospitals due to its flexibility and ease of problem detection. Each device connects to a central hub, ensuring that issues in one workstation do not affect others. Nonetheless, the central hub represents a single point of failure, and the installation costs can be high due to the extensive cabling required (Seipalla et al., 2023).

2.1.3 Ring Topology

This configuration allows for improved performance over bus topology and is relatively easy to implement. However, it can become complicated if one connection fails, affecting the entire network (Seipalla et al., 2023).

2.1.4 Mesh Topology

Known for its robustness, this topology offers multiple paths for data transmission, enhancing security and minimizing data collisions. Its complexity and high installation costs, however, can be a barrier for many hospitals (Seipalla et al., 2023).

2.1.5 Tree Topology

A hybrid of star and bus topologies, it allows for hierarchical data management but can suffer from performance issues if the central node fails. It is ideal for hospitals with multiple departments, as it supports isolated networks for each department (Seipalla et al., 2023).

2.1.6 Hybrid Topology

This combines various topologies tailored to specific needs within the hospital, offering flexibility and scalability. However, it poses challenges in management and higher costs (Seipalla et al., 2023).

2.2 Importance of Network Design in Healthcare

The choice of network topology is critical for ensuring high service availability and protecting patient data. As highlighted by Seipalla et al. (2023), hospitals must prioritize data integration, security, and maintenance in their network design to enhance patient care and operational efficiency. The authors conclude that a well-designed network architecture is essential for optimizing hospital management systems.

2.2.1 Figures from Related Studies

Figure 1 from Rachmawati and Haryanti (2023) illustrates an e-health grid network topology based on referral systems, showcasing the interconnectedness of various healthcare entities and how they communicate effectively within a grid structure. This topology emphasizes the importance of seamless data exchange and integration across different healthcare services.

Figure 1. Logical Network Topology in Danube Hospital

2.3 Conclusion

The literature underscores the critical role of network topology in hospital management systems. By selecting appropriate topologies, hospitals can enhance data security, ensure service availability, and improve overall patient satisfaction. Future research should continue to explore innovative network designs that cater to the evolving needs of healthcare environments.

Chapter III: Technical Background

The development of BOGOH's IP telephony system required a sophisticated simulation of network connectivity and integration across multiple sites: the main hospital, a rehabilitation center, and an affiliated clinic. To address this, the proponents employed advanced tools and methodologies.

3.1 Simulation Tools

3.1.1 Cisco Packet Tracer

Cisco Packet Tracer was integral for the simulation and validation of the network design. Specifically, its **Multi-User feature** was utilized to simulate connectivity between geographically dispersed locations. This capability allowed the team to replicate realistic network scenarios involving:

- **Main Hospital**: Centralized hub for voice and data communications.
- **Rehabilitation Center**: A site requiring seamless connectivity for telemedicine consultations and administrative coordination.
- **Clinic**: A smaller facility dependent on reliable access to the hospital's systems.

The **Multi-User functionality** provided a virtual environment to test the end-to-end connection of these sites over simulated WAN links. This ensured that the proposed system could handle the required distance and data loads effectively.

3.1.2 Key Applications of Packet Tracer

- **WAN Emulation**: Simulated long-distance links between sites, incorporating delays and bandwidth limits for a realistic assessment.

- **Routing Protocol Configuration**: Implemented protocols such as OSPF or EIGRP to manage data flow efficiently.

- **QoS Testing**: Ensured that voice packets maintained priority for uninterrupted communication.

3.2 Visualization and Floor Plan Tools

The proponents utilized **EDrawMax** and **LucidChart** to create logical and physical layouts:

- **EDrawMax**: Designed detailed network topologies showcasing the integration of IP phones, routers, and switches.

- **LucidChart**: Created floor plans marking the placement of telephony equipment within hospital facilities and their extensions.

3.3 System Design and Architecture

The proposed IP telephony system was designed to address the hospital's unique requirements:

- **Inter-Site Communication**: Enabled through virtual private networks (VPNs) to securely connect the hospital, rehab center, and clinic.

- **Redundancy**: Incorporated backup connectivity to prevent downtime.

- **Scalability**: Allowed for future expansions, such as additional clinics or service areas.

3.4 Rationale for Multi-User Packet Tracer Usage

The inclusion of the **Multi-User feature** in Packet Tracer was critical in demonstrating the practicality of distanced connectivity between the main hospital and its satellite sites. It provided:

- A **cost-effective simulation environment** for testing WAN links without physical infrastructure.
- **Collaborative testing**, enabling team members to work on different aspects of the network design simultaneously across virtualized environments.

3.5 Summary

The technical groundwork for BOGOH's IP telephony system leverages innovative tools like Cisco Packet Tracer with Multi-User capabilities, EDrawMax, and LucidChart. This integrated approach allowed the proponents to create a reliable, efficient, and future-proof communication network, ensuring seamless connectivity across its facilities. This project not only addresses current demands but also sets a foundation for scalable healthcare services in the future.

Chapter IV: Methodology

The BOGOH Hospital is a multi-level facility designed to deliver comprehensive healthcare services. This part of the paper presents the floor plans for the three buildings: the Main Hospital, General Clinic, and Rehab Center, each featuring several distinct departments within their structures.
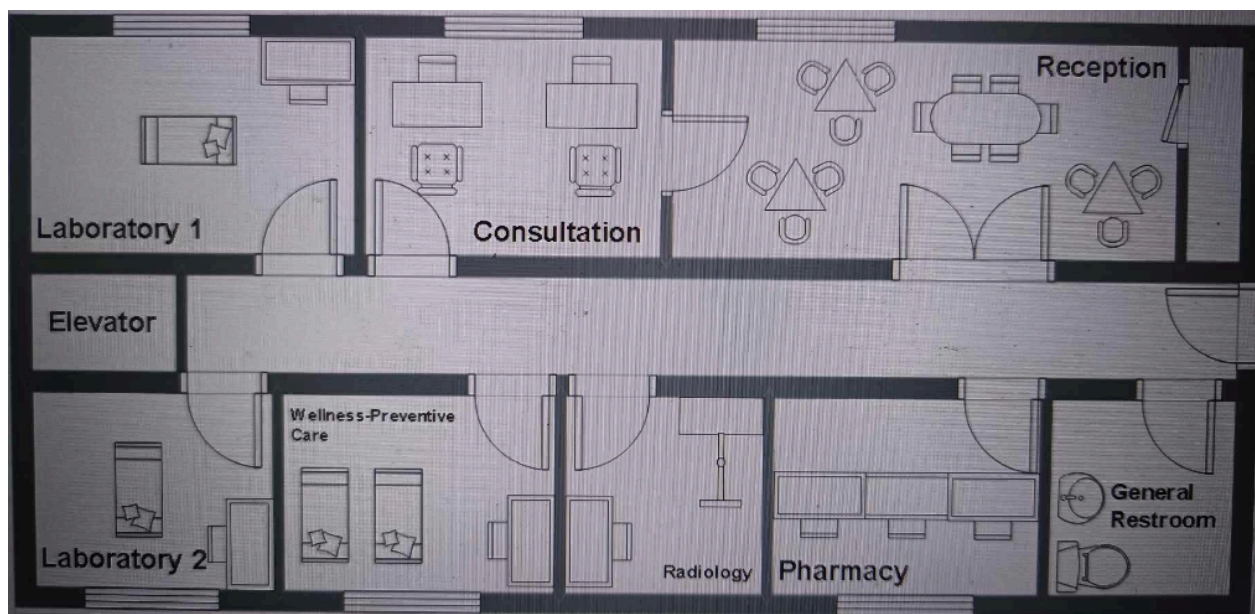

Figure 1. BOGOH Hospital First Floor

Figure 1 showcases the first floor, which serves as the central hub for patient reception and primary services, including the **Reception** area, **Pharmacy**, **Consultation** rooms, and **Wellness-Preventive Care** services. It also houses diagnostic facilities such as **Radiology** and two **Laboratories**, ensuring patients can receive prompt diagnostic evaluations. A general restroom is conveniently accessible on this floor.

Figure 2. BOGOH Hospital Second Floor

The second floor focuses on urgent care and recovery services. It includes four **Urgent Care Rooms** (1–4) for immediate medical needs, a **Billing** section for financial transactions, a **Physical Therapy unit** for rehabilitation services, and a **Cafeteria** for patient and staff nourishment. Like the first floor, a **general restroom** is available.
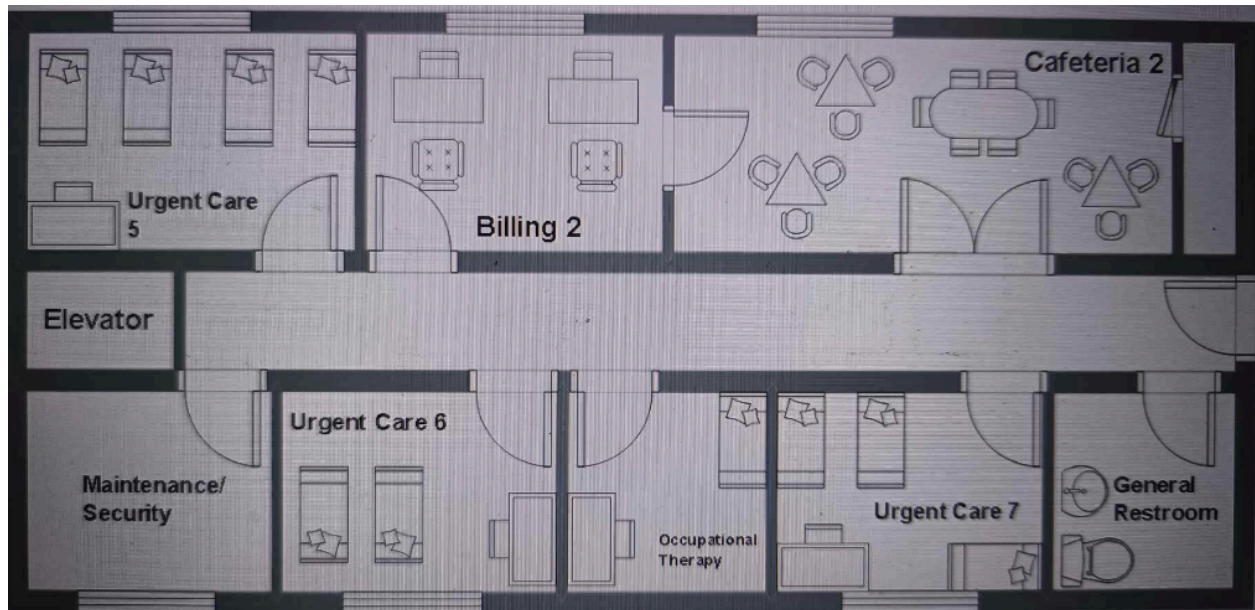
Figure 3. BOGOH Hospital Third Floor

On the third floor, operational and additional care spaces are provided. This floor accommodates the **Maintenance/Security offices**, a second **Billing** section, three additional **Urgent Care Rooms** (5–7), and an **Occupational Therapy unit**. To ensure convenience, the floor also features a second **Cafeteria** and a **general restroom** for use by staff and visitors.
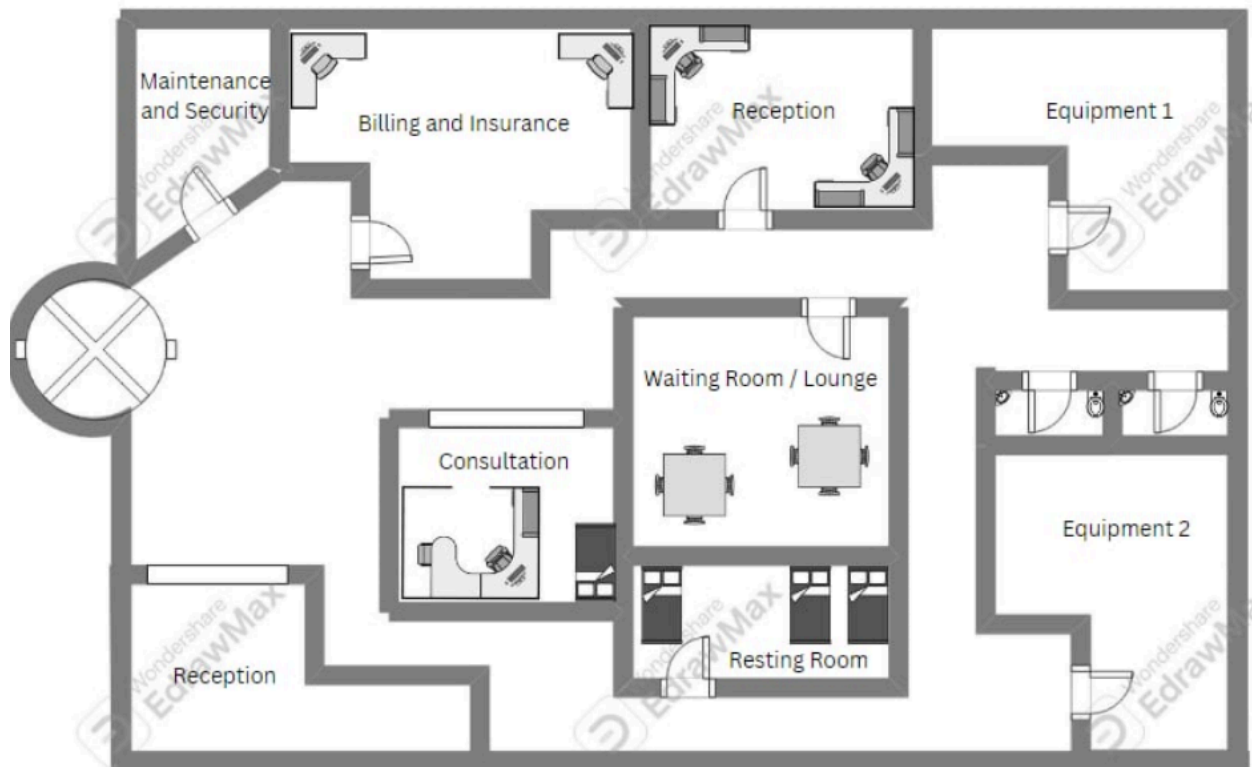
Figure 4. BOGOH General Clinic

The BOGOH General Clinic is a dedicated outpatient facility designed to streamline medical consultations and support services. The **Reception areas** and **Waiting Room/Lounge** offer a welcoming and efficient environment for patient intake and waiting. Financial and insurance transactions are handled in the **Billing and Insurance** section. For specialized procedures, the clinic is equipped with **Equipment Rooms 1 and 2**, ensuring all necessary tools are readily available.

The clinic also includes a **Resting Room** for patient or staff use, creating a comfortable space for recovery or breaks. **Consultation rooms** provide private settings for doctor-patient interactions, while the **Maintenance and Security** section ensures the clinic operates smoothly

and securely. With its comprehensive layout, the General Clinic serves as a hub for non-critical medical services.
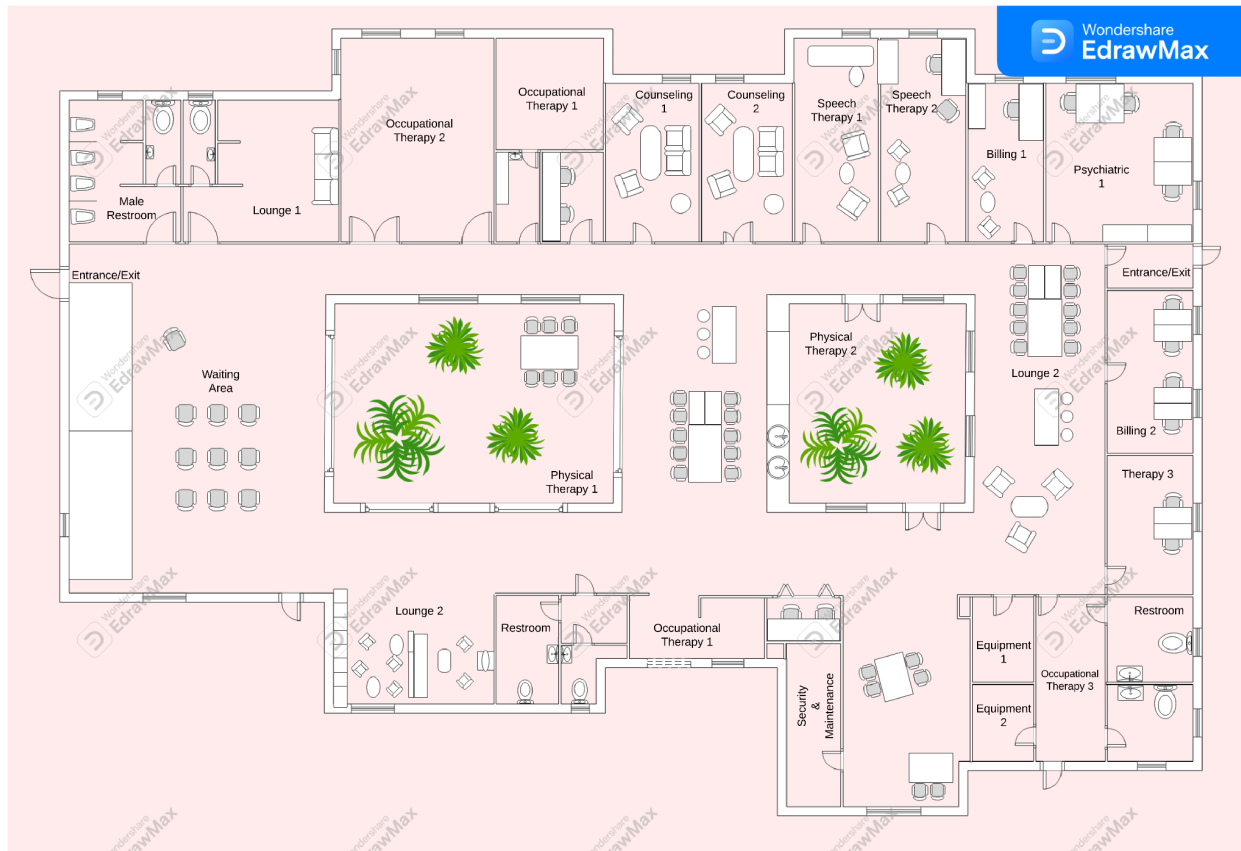

Figure 5. BOGOH Rehab Center

The BOGOH Rehab Center is a specialized facility focused on therapy and rehabilitation services. It features three **Occupational Therapy rooms** and three **Physical Therapy rooms**, each designed to support patients in regaining mobility and independence. Additionally, the center includes two **Speech Therapy rooms** for addressing communication challenges and two **Counseling rooms** for mental health support. For psychiatric care, a dedicated **Psychiatric room** is available.

Administrative functions are supported by two **Billing offices**, while two **Equipment rooms** store the tools required for various therapies. The **Waiting Area** provides a comfortable space for patients and families, and the **Security and Maintenance** section ensures the center operates safely and efficiently. With its broad range of services, the Rehab Center is a cornerstone for recovery and mental wellness.
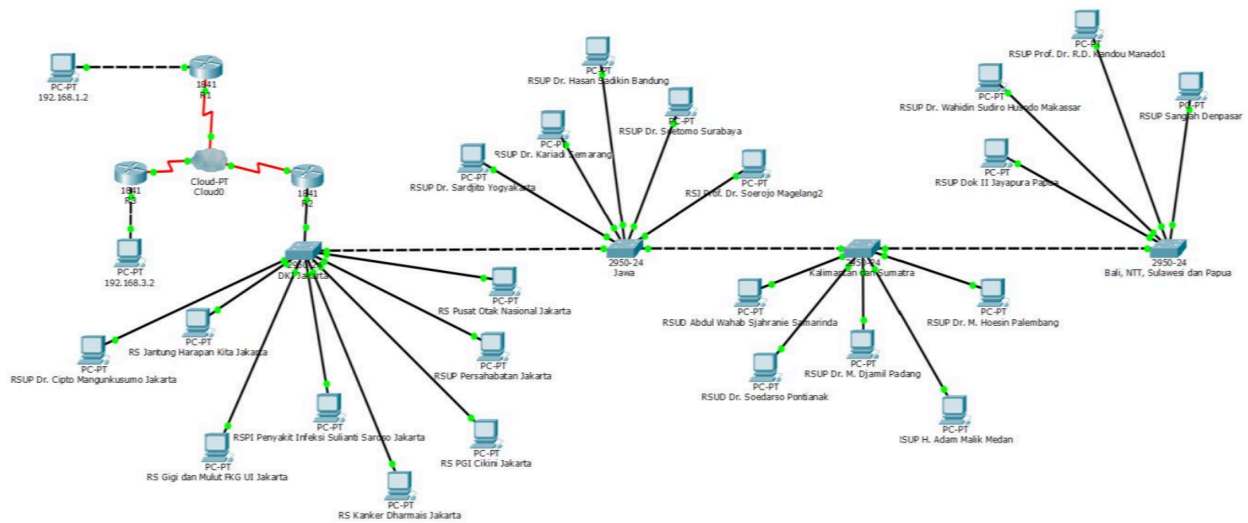
Appendices

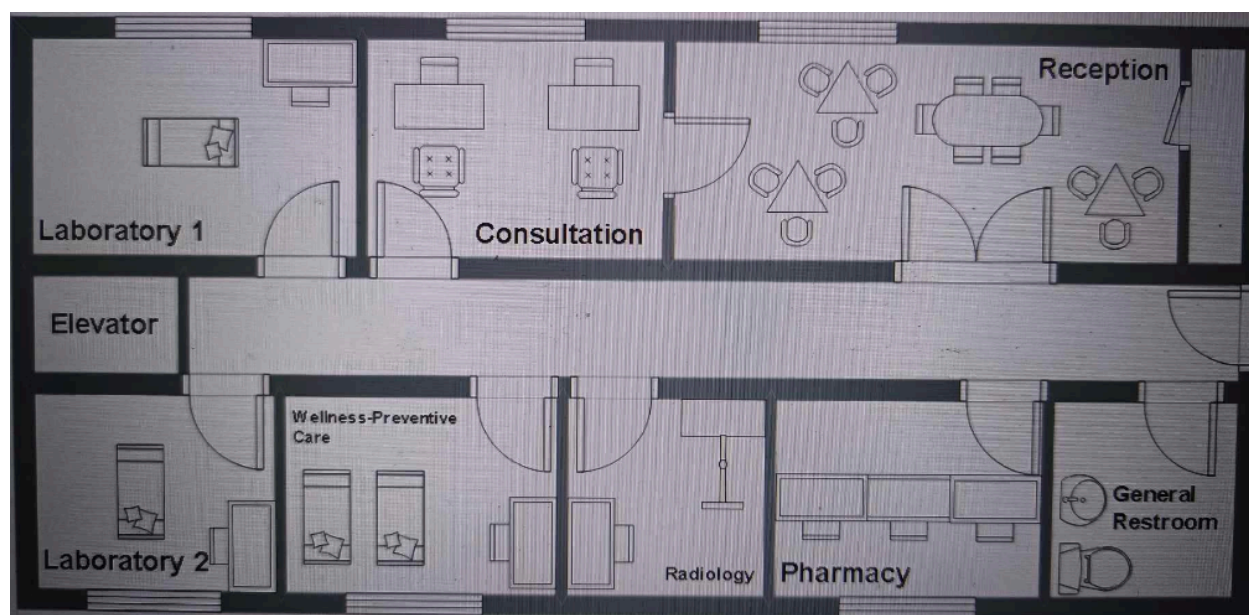*Figure 2.1.* Logical Network Topology in Danube Hospital
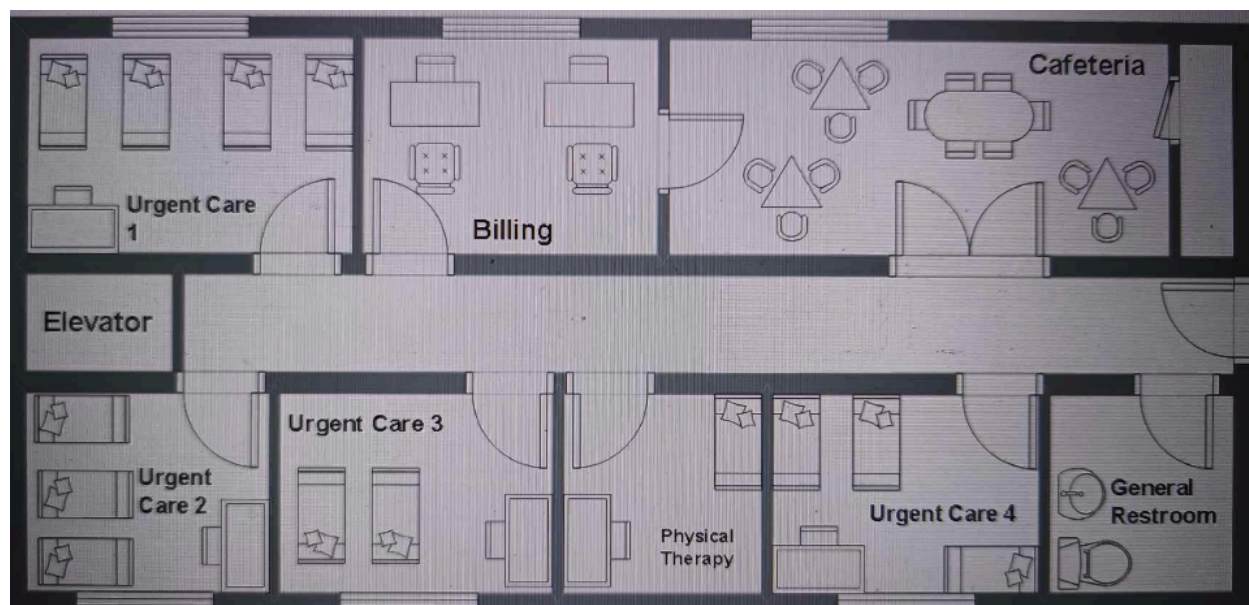
Figure 4.1. BOGOH First Floor
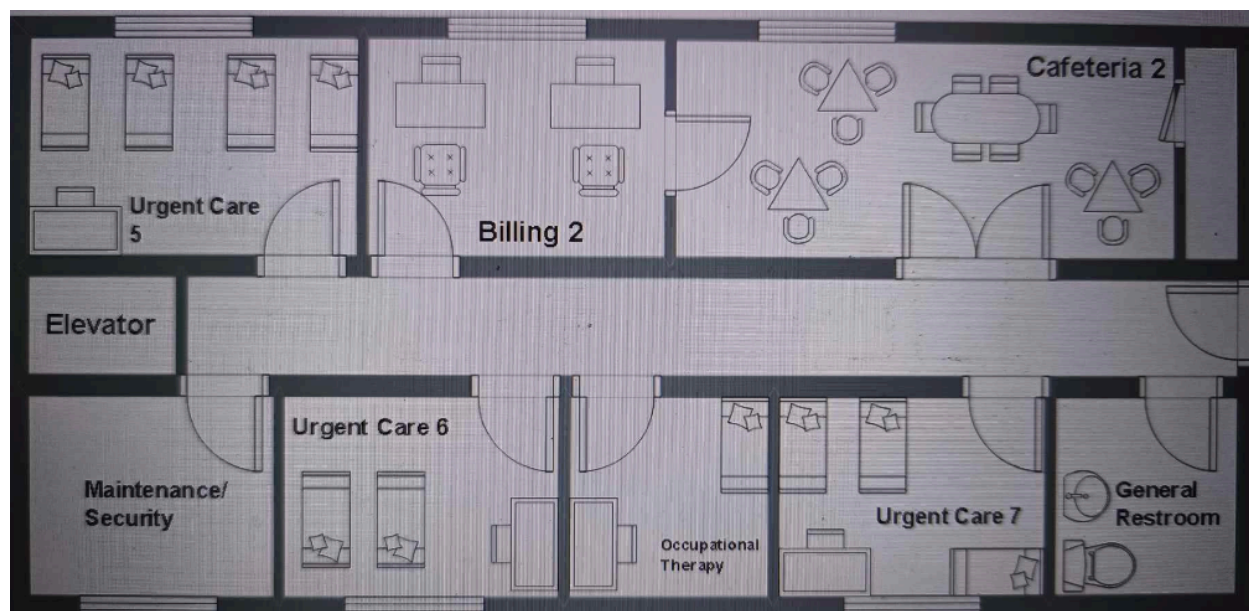

Figure 4.2. BOGOH Second Floor
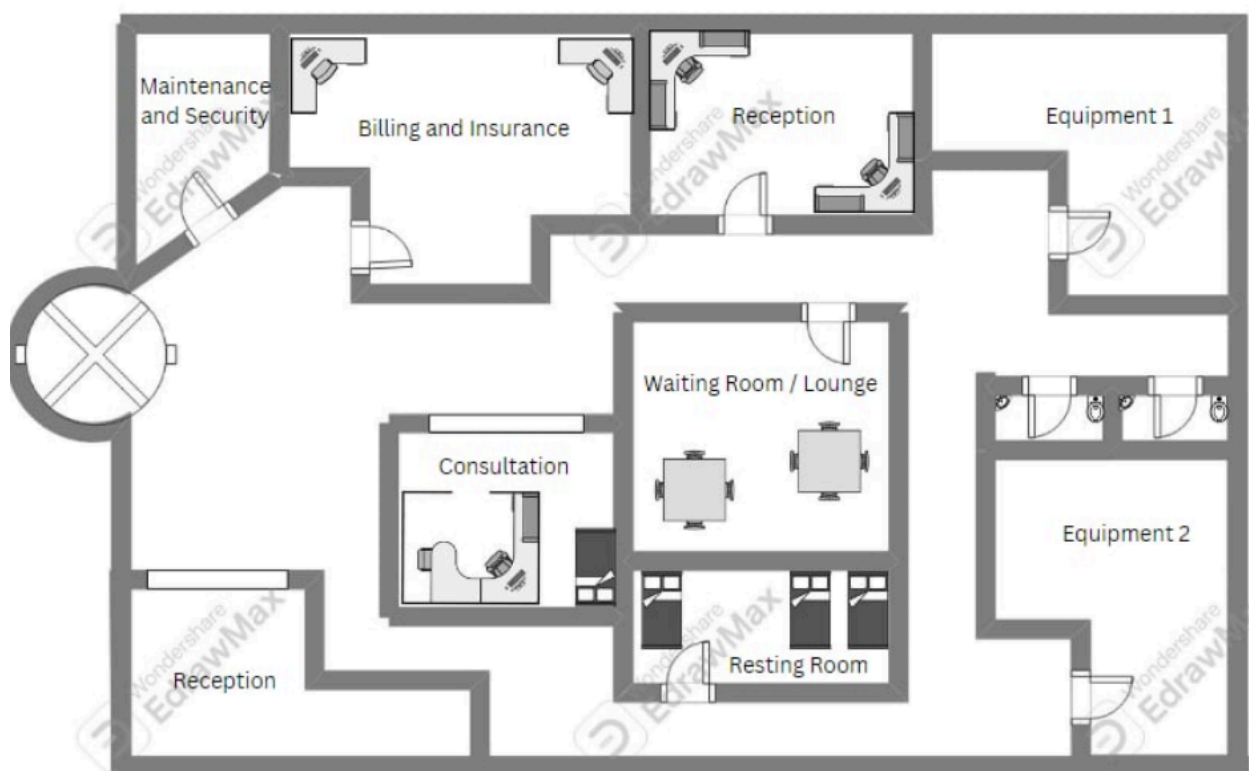
Figure 4.3. BOGOH Third Floor

Figure 4.4. BOGOH General Clinic

Figure 4.5. BOGOH Rehab Center

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