



ANALYSIS OF HEALTHCARE SYSTEM TOWARDS IMPROVEMENT

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ABSTRACT: *This research aims to analyse the current health system at the Papua New Guinea University of Technology (PNGUOT) clinic by identifying ways to improve the healthcare services for students and staff. The clinic provides for the university community and the surrounding population. However, the clinic faces several challenges. The results reflect more widespread issues faced by healthcare facilities in Papua New Guinea, where infrastructural limitations can affect effective service delivery. This study provides actionable recommendations better to meet the evolving health needs of its users.*

KEYWORDS: Healthcare, Accessibility, Quality, University, Papua New Guinea.

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INTRODUCTION

In recent times, the quality of education in health services has been a matter of increasing concern in educational institutions. The Papua New Guinea University of Technology (Unitech), with its range of students and staff, has a special challenge in delivering effective healthcare to its community. The PNGUOT Clinic provides health-related support for general health and academic performance. The clinic has been providing an array of services since its expansion in 1982. The clinic further contributes to educating the university community through lectures and training in preventive medicine and first aid.

Yet past experiences and user input indicate that many of the patients face challenges to access these offerings, such as long waiting times, appointment scheduling issues and the lack of specialised care. These problems have been further compounded by larger systemic issues that are pervasive within Papua New Guinea's health system, which all healthcare providers face, including funding limitations, infrastructural shortages, and the presence of biomedical, traditional and faith-based health services working alongside each other. These issues can compromise the continuity and efficiency of the delivery of care. And it becomes even more critical to determine which are the variables that influence the quality and the access to care.

Therefore, it is important to investigate the specific needs of the university community and the operational challenges faced by the clinic. This research is guided by the primary research question: **How can the quality and accessibility of healthcare services at the Papua New Guinea University of Technology clinic be improved?**

MATERIALS AND METHODS

Most of the data was collected and gathered through surveys, interviews, and observations, this made it possible for us to have a more thorough understanding of both the operational aspects of the clinic and the experiences of its users. By integrating qualitative and quantitative approaches to comprehensively evaluate the quality and accessibility of healthcare services at the Papua New Guinea University of Technology (PNGUOT) Clinic.

i. Surveys

Twenty-five individuals, who included students and staff, filled out structured questionnaires. Data on patient satisfaction, frequency of clinic visits, types of services used, and barriers to accessing care was collected. Then it was further analysed using statistical software, with descriptive statistics summarising user demographics and satisfaction tallies. Regression analysis was also applied to identify correlations between service usage patterns and satisfaction outcomes.

ii. Interviews

Semi-structured interviews were conducted with clinic staff, specifically the Chief Medical Officer and nursing personnel. This was mainly used to gather in-depth insights into the clinic's service delivery processes and challenges faced by healthcare providers.

iii. Observations

Direct observations of clinic operations were done over four weeks to assess the clinic environment, workflow efficiency, and resource utilisation. The observation was focused on patient flow, appointment scheduling procedures, and availability of medical resources. This method provided valuable related data to complement findings from interviews and surveys, highlighting practical challenges and opportunities for improvement.

Data Collection Procedure

The survey data were collected from 25 clinic users, comprising both students and staff from the university. The graph below illustrates the distribution of respondents.

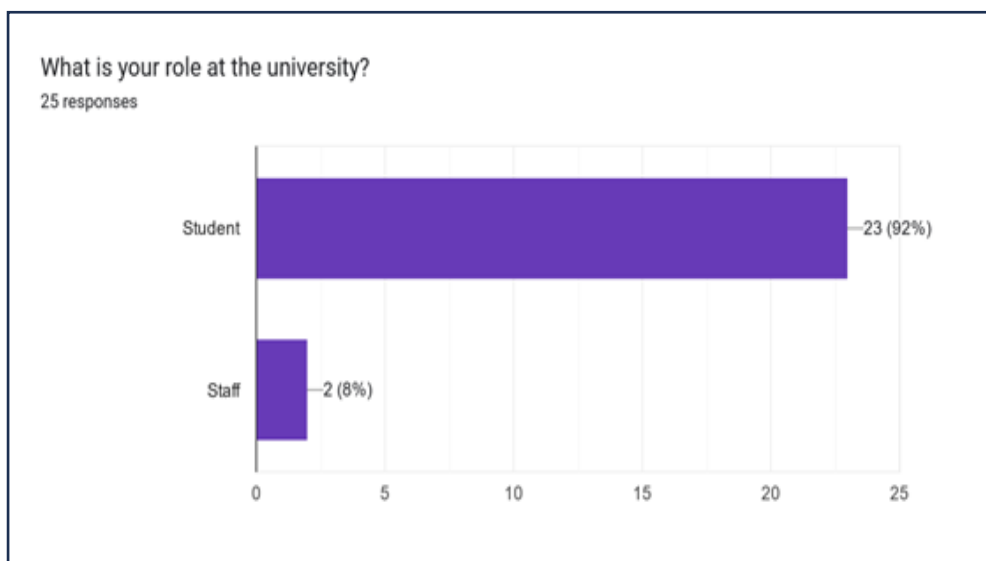


Figure 1: Graph depicting respondent population.

The survey was made up of five main questions targeted at finding out about individuals' experiences at the university clinic: The Questions are as follows:

1. What is your role at the University?
2. How frequently do you visit the university clinic?
3. What are the main barriers you face when trying to access healthcare services?
4. How would you rate the quality of healthcare services provided by the university clinic?
5. What additional healthcare services would you like the clinic to provide?

RESULTS

The following are the results for each question from the survey:

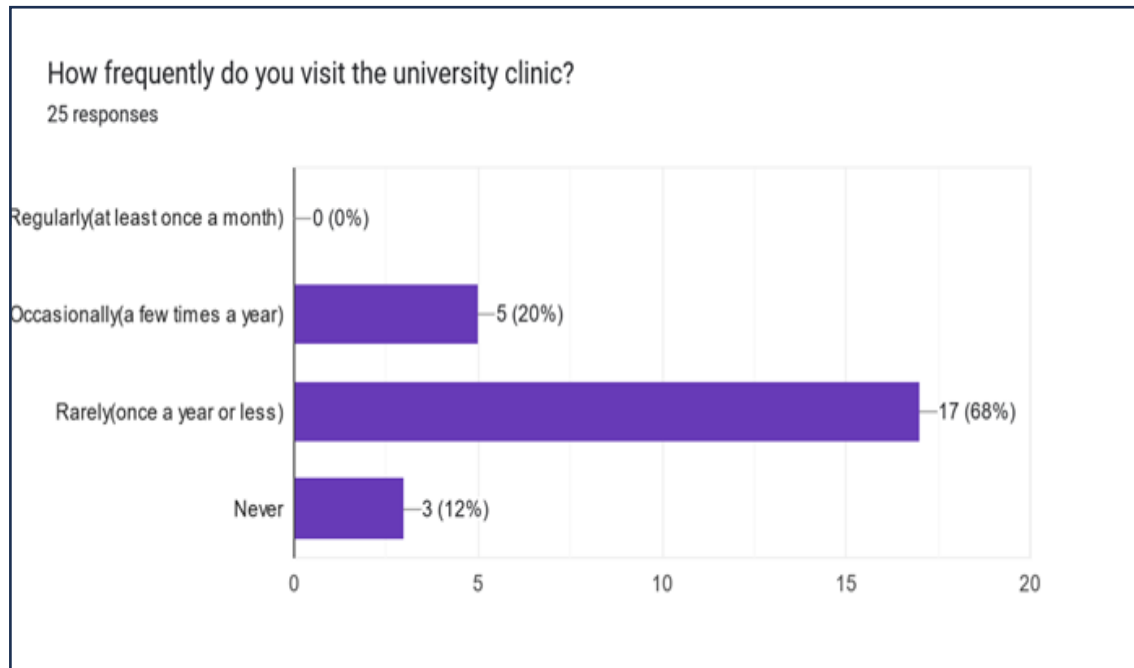


Figure 2: Bar graph depicting results from Question 3.

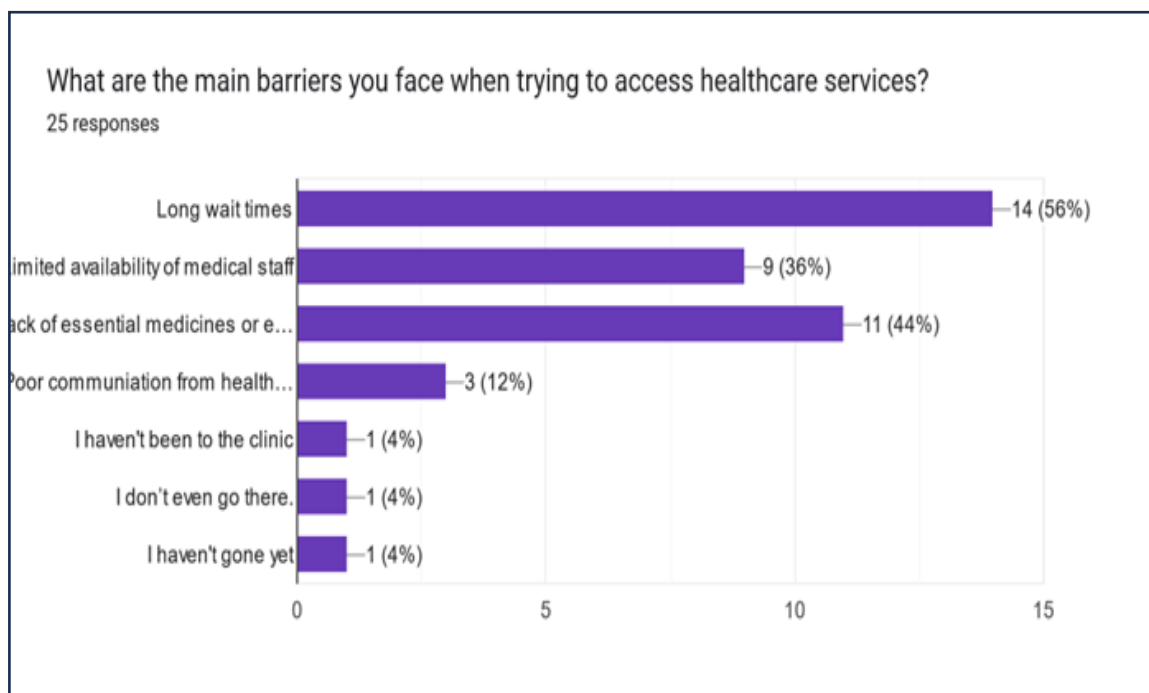


Figure 3: Bar graph depicting results from Question 2.

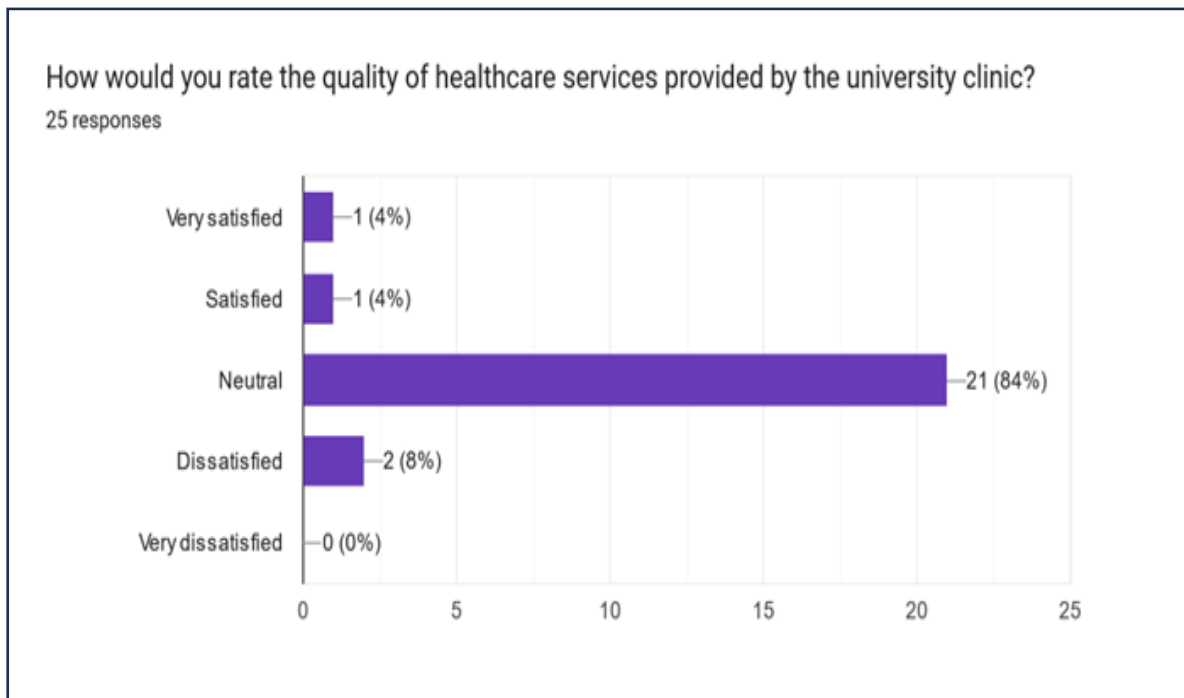


Figure 4: Bar graph depicting results from Question 4.

Question 5

Responses to Question 5 (“What additional healthcare services would you like the clinic to provide?”) were collected in an open-ended format. This allowed participants to elaborate on their specific needs and suggestions in their own words. Common themes identified from these open-ended responses included requests for blood tests, dental services, 24-hour operation, and improved diagnostic equipment.

Data Analysis

According to Survey

Respondent Overview

- Total responses: 25
- Roles: Predominantly Student (23 out of 25), with a small number of Staff respondents.
- Data fields: Role, clinic visit frequency, barriers to access, quality ratings, and suggestions for new services.



KEY FINDINGS

1. Frequency of Clinic Visits

- Most respondents visit the university clinic rarely (once a year or less); this is the most common response (17 out of 25).
- A smaller number visit occasionally (a few times a year).
- Very few never visit the clinic.

2. Barriers to Access

- The most frequently cited barrier is long wait times (6 mentions as the top barrier).
- Other common barriers:
 - Limited availability of medical staff
 - Lack of essential medicines or equipment
 - Poor communication from healthcare staff
- Some respondents indicated they have not visited the clinic yet, citing lack of experience.

3. Quality of Healthcare Services

- Neutral is by far the most common rating for service quality (21 out of 25 responses).
- Only a few respondents expressed being Very satisfied, Satisfied, or Dissatisfied.

4. Suggestions for Additional Services

- Responses are highly varied, but common themes include:
 - Requests for better testing equipment (e.g., blood tests, x-rays)
 - Dental and nutrition services
 - 24-hour operation or extended hours
 - Improved medication availability
 - Some respondents are satisfied and do not request changes.



Summary Table

Question	Most Common Response(s)	Frequency
Role at university	Student	23
Frequency of clinic visits	Rarely (once a year or less)	17
Main barriers to healthcare access	Long wait times, Limited staff, Lack of medicines	6+
Quality of healthcare services	Neutral	21
Additional services requested	Better testing, dental, 24hr service, more medication	Varie

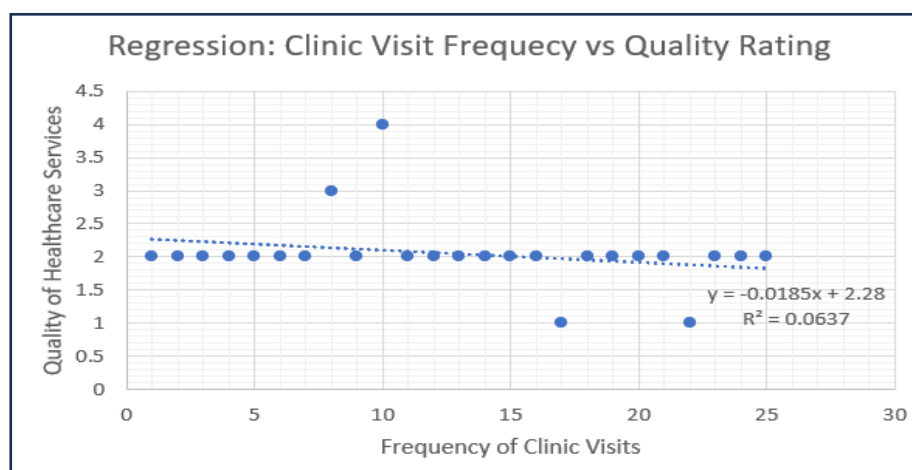
Applications of Mathematics

Mathematics plays a crucial role in the analysis and improvement of healthcare systems, providing powerful tools for understanding complex operational challenges and informing evidence-based decision-making. In this project, mathematical concepts and statistical methods were applied to systematically evaluate the performance of the PNGUOT Clinic and to identify key factors affecting service quality and accessibility. Techniques such as regression analysis, descriptive statistics, and basic modelling allowed for the quantification of relationships between patient satisfaction, clinic utilization, and operational barriers. This section highlights the specific ways in which mathematics was integrated into the research process and demonstrates its value in supporting effective healthcare management and policy development.

The following are key mathematical applications in healthcare optimization:

1. Regression Analysis

Using regression analysis, we identified correlations between clinic utilization patterns (e.g., infrequent visits) and dissatisfaction drivers (long wait times, staff shortages) using patient survey data. And also enabled targeted prioritization: wait time reduction and staff allocation emerged as critical leverage points for improving satisfaction.



Graph 1: Scatter plot with regression line illustrating the link between visit frequency and quality ratings at the university clinic.



This scatterplot illustrates the relationship between the frequency of clinic visits and the perceived quality of healthcare services among university respondents. Each point represents an individual's response, with the x-axis showing how often they visit the clinic and the y-axis showing their rating of service quality (from 1 = Dissatisfied to 4 = Very satisfied).

The dotted regression line summarises the overall trend. The equation $y = -0.0185x + 2.28$ indicates a very slight negative relationship: as the frequency of clinic visits increases, the perceived quality rating tends to decrease a little. However, the R^2 value (0.0637) is very low, meaning that the frequency of visits explains only about 6% of the variation in quality ratings. This suggests there is **no strong association** between how often respondents visit the clinic and how they rate its services – most people give similar quality ratings regardless of visit frequency.

2. Descriptive Statistics

Descriptive statistics played a fundamental role in this research by summarising and presenting the key features of the data collected from the PNGUOT Clinic survey. By calculating frequencies, percentages, and central tendencies (such as the most common response), descriptive statistics provided a clear overview of respondent demographics, clinic usage patterns, and satisfaction levels. For example, the analysis revealed that 68% of respondents (17 out of 25) visited the clinic rarely (once a year or less), and 84% (21 out of 25) rated the quality of healthcare services as "neutral". Descriptive statistics changed the raw survey data into meaningful insights that guided further analysis and informed practical recommendations for improving clinic operations.

3. Basic Modelling

Basic modelling was to facilitate understanding and to describe the operational challenges faced by the PNGUOT Clinic. A basic queue model was used to conceptualise how patients move from arrival to consultation, highlighting bottlenecks due to understaffing and long waiting times. With this model, there was a better understanding of the relationships between clinic capacity, patient demand, and service quality. The use of basic modelling enabled us to find where, in terms of system performance, improvement was imminently necessary.

Patient Flow Queue Model Diagram:

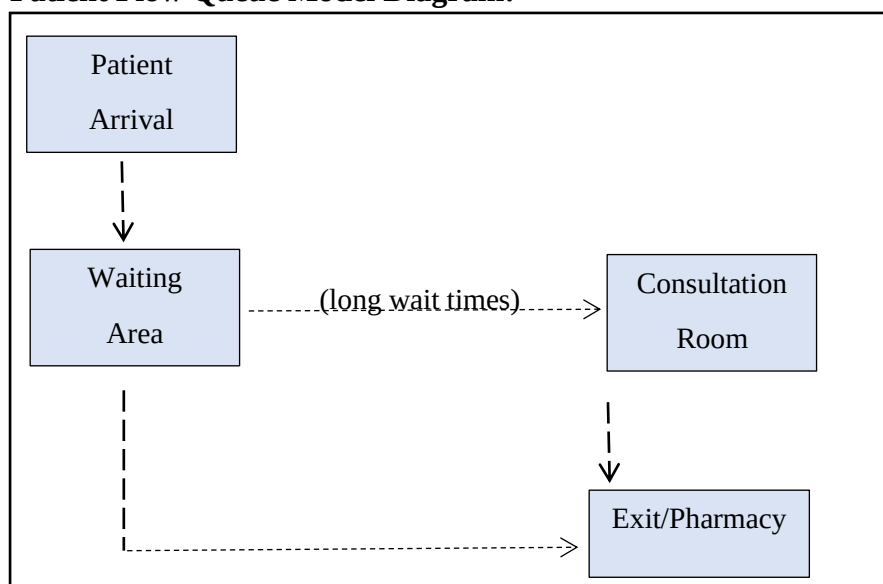


Diagram 1: Basic queue model of patient flow at the PNGUOT Clinic.

**Legend:**

- **Patient Arrival:** Patients enter the clinic and register.
- **Waiting Area:** Patients wait for their turn; bottlenecks often occur here due to limited staff.
- **Consultation Room:** Patients are seen by medical staff.
- **Exit/Pharmacy/Lab:** Patients either leave, collect medication, or are referred for tests.

DISCUSSIONS & RECOMMENDATIONS

The results of this survey provide valuable perspectives about how students and staff view the healthcare services offered by the university clinic. Most respondents were students, most visiting the clinic rarely (once a year or less) or occasionally (a few times a year). This suggests that while the clinic is utilised, it may not be most students' primary healthcare source.

Long waiting times, less medical staff, and unavailability of resources were frequently reported as challenges to accessing health care. These barriers were highlighted by both students and staff, suggesting clinic-level problems in coordinating operations and resource distribution. Most of the respondents were either 'Neutral' in evaluation of service quality, with only a few having cause for satisfaction or dissatisfaction. This neutrality could indicate that many have not had particularly good or bad experiences and thus have moderate expectations of the clinic.

Question 5 was open-ended, allowing respondents to freely express their suggestions for additional services. Thematic analysis of these responses revealed several recurring requests, including the need for better diagnostic equipment (such as blood tests and x-rays), a dental unit, 24-hour service, specialised healthcare (e.g., women's and men's health, sports medicine, dermatology), and more comprehensive medication availability. Some respondents also highlighted the importance of health awareness programmes and improved patient attention.

It is notable that a subset of respondents had never visited the clinic and were thus unable to comment on barriers or service quality. This points to a possible lack of awareness or perceived need for the clinic's services among some students. Overall, the survey results suggest that while the clinic provides essential services, there are clear opportunities for improvement in terms of resources, accessibility, and service offerings.

Based on the survey findings, the following recommendations are proposed to enhance the quality and accessibility of healthcare services at the university clinic:

1. **Reduce Wait Times:**
 - Streamline patient intake and triage processes.
 - Consider increasing the number of healthcare staff during peak hours.
2. **Increase Medical Staff and Training:**
 - Recruit additional qualified medical personnel.



- More staff training
- 3. Upgrade Equipment and Medication Supply
- 4. Expand Service Offerings:
 - Additional health services
 - 24-hour service to meet student needs.
- 5. Enhance Health Education and Awareness.
- 6. Improve Communication

These recommendations could improve the student and staff experience at the university clinic, leading to higher satisfaction and better health outcomes.

Additional mathematical approaches:

- Data Analysis
- Health Data collection and Trend Analysis
- Improving Efficiency and Cost-Effectiveness
- Predictive Analytics for Healthcare Planning
- Emergency Healthcare Planning

Mathematical tools such as statistical analysis and predictive modelling, the Papua New Guinea University of Technology clinic can improve its decision-making processes. This would widely contribute to better healthcare services that are more responsive to the needs of students and staff.

Conclusion

To conclude, this study has assessed the Papua New Guinea University of Technology (PNGUOT) Clinic and its part in caring for the university community. Results have indicated that despite the clinic's array of services, users still experience barriers, including wait times, staffing shortages, and a lack of access to speciality care and equipment.

This research project has focused on the needs of patients to improve the quality of care at the PNGUOT Clinic. With the recommendations put into place, this offers a pathway for the clinic to better meet the evolving health needs of its users and contribute to improved well-being and academic success within the university community.

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