# KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI

## COLLEGE OF SCIENCE

## DEPARTMENT OF MATHEMATICS

**TOPIC:**

# *"THE ROLE OF INVENTORY MANAGEMENT ON EFFICIENT HEALTHCARE DELIVERY: THE CASE STUDY OF CAPE COAST METROPOLITAN HOSPITAL"*



***A THESIS SUBMITTED TO THE DEPARTMENT OF MATHEMATICS IN PARTIAL FULFILLMENT OF REQUIREMENT FOR THE AWARD OF MASTER OF SCIENCE IN INDUSTRIAL MATHEMATICS.***

**BY**

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# DECLARATION

I hereby declare that this submission is my own work towards the MSc. Industrial Mathematics and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.



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# DEDICATION

This work is dedicated to my lovely wife Faustina Arkoh, my gifted children Emmanuel Aidoo-Acquah, Frederica Acquah and Kweku Bentsi-Acquah and my supporting father, Mr. Jonathan Annan, a lecturer at the School of Business, KNUST.



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## ABSTRACT

Inventory management is a very important aspect in all sectors of the economy with the aim to hold inventories at the lowest cost possible, given the objectives to ensure uninterrupted supplies. As much as inventory managers are trying hard to ensure customer service does not suffer because of low inventories, they also ensure that resources are not tied up and this could be ensured only when proper inventory management systems are practiced. Inventory management problems like stock outs of medical supplies, expiry of supplies and overstocking are some of the inefficiencies hampering an efficient health care delivery. It is in line with all these difficulties that I undertook this research to show how inventory management could be improved in Cape Coast Metropolitan Hospital. In order to realise the desired outcome, fifty (50) samples of drugs were collected from the hospital's pharmacy to determine the optimal order quantity for each drug. Inadequate funds, facilities and non-incorporation of IT are some of the challenges hindering a proper inventory management system in the hospital. From the analysis I realised that there are vast differences in values in terms of the quantity of inventory that the organization holds/orders, and the cost associated with holding each item/drug. Holding the variables that affect the calculation of the optimal quantities constant, the hospital will realize enhance performance in terms of reducing stocks-outs, reduction in capital lock-up, increasing drug availability, and increasing customer/patient satisfaction.

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# CHAPTER ONE

# GENERAL INTRODUCTION

## 1.0 Introduction

The healthcare industry is experiencing disturbing trends related to cost, quality, and increased competition. Interest in improving performance in these areas has increased in recent years, highlighting the need for better operational coordination of healthcare delivery. Inventory Management is an essential function in business circle of which our health centres cannot be left out. Good inventory management practices create a competitive edge by delivering quality good(s) or services at the right time and offering lower cost by cutting its own cost as well as cutting purchased items costs.

The aim of inventory management is to hold inventories at the lowest possible cost, given the objectives to ensure uninterrupted supplies for ongoing operations .When making decisions on inventory, management has to find a compromise between the different cost components, such as the costs of supplying inventory, inventory holding cost and cost resulting from insufficient inventories (Hugo et al, 2002).

## 1.1 Background of the study

Historically, organisations used to carry high stocks, which they almost viewed as a sign of wealth (Waters, 2003).This was done forgetting some valuable cash was locked up which could have been used in other development agendas.

There is the need for hospital supplies to be available when needed and our hospitals have to be proactive in that sense. Situations and conditions in most of our hospitals are the same with respect to managing inventory and this has been in existence since independence.

Inventory at our hospitals include drugs, syringes, blades, drips, gloves and other essential health materials which needs special care and storage and there is the need for management to ensure their availability. Most inventory management prevailing conditions are that our hospitals fail to recognise the importance of managing inventory by not devoting resources to that aspect. Some hospitals overstock with one supply or the other tying up cash, which can be used for other purposes. The reverse is also worrisome, where they run out of critical supplies at the needed times. Obsolescence and expiration of drugs is also prominent in our health centres because most at times procurements are done without cognisance to the demand and expiring dates of these drugs.



According to Monczka et al (2010), "inventories are the stores of materials that an organisation has acquired, but it is not ready for use". Inventory Control however according to Wild (2002), is the activity which organises the availability of items to the customers. Inventory management is therefore of great importance especially for managers who must decide how much (if any) to hold to prevent cash being tied up and how to administer the rest of the logistics system more creatively in order to ensure that customer service does not suffer as a result of lower inventory levels.

It is about time management takes steps to cut down some of these situations of inventory stockouts by improving on their current management practices. They really need to get people to handle the inventory part of their operations. Efficient health care cannot be provided unless required material is available in adequate quantity and also desired condition. Materials management plays a crucial role in providing efficient healthcare by touching three vital aspects of medical supplies used in the hospitals viz. availability, safety

and affordability. A good inventory management is always patient-centred. While inventory is concerned with monetary issues, hospitals are in the business of serving patients.

This study is important to health care delivery as well as the economy as a whole. This is because it identifies the role of inventory management in healthcare delivery. Determining the Economic Order Quantity for essential health materials at the hospital will also reduce time wasting to ensure higher productivity, improve discharge of duties of healthcare professionals and encourage people to seek medical attention from the hospital when they fall sick.

The main objectives for this study are to determine the inventory management models being used at Cape Coast Metropolitan Hospital, to assess the relationship between good inventory management and efficient health care delivery at Cape Coast Metropolitan Hospital, to determine Economic Order Quantity of drugs to be kept at Cape Coast Metropolitan Hospital using the EOQ model and to establish an effective and efficient inventory control practices that may lead to effective and efficient healthcare delivery.

This study is to analyze the theory and instances of inventory management practices in healthcare organizations around the world and especially in Ghana and assess the benefits that can be accrued from good inventory management practices in healthcare.

## 1.2 Statement of the problem

The success of every venture depends on its ability to provide services to its customers or users and remain financially viable. For an organisation, which is supplying goods to its customers, the major activity is to have the needed products available at an acceptable price within a reasonable time scale. Inventory control is the activity which organises the

availability of items to the customers. Hospitals keep a lot of inventory. The purpose of this research is to ensure that stock controls at the hospital meet their required demand to contribute to the welfare of the whole organisation. Shortages of drugs and other essential medical supplies due to improper or inefficient inventory management practices can result in loss of life, increased cost of running the hospital as a result of stock out of essential drugs, customer dissatisfaction, etc. Hence, the research seeks to determine practices that can result in efficient inventory control.



## 1.3 Research objectives

The general objective of the study is to assess the role of inventory management on efficient healthcare delivery specifically using Cape Coast Metropolitan hospital.

The specific objectives of the study are;

1. To investigate the inventory management practices at Cape Coast Metropolitan Hospital.
2. To determine the Economic Order Quantity of drugs to be kept at Cape Coast Metropolitan Hospital using the EOQ model.

## 1.4 Research questions

The research questions of the study are;

1. What are the inventory management practices being used at Cape Coast metropolitan hospital?
2. What are the optimal quantities of essential drugs to be kept at Cape Coast Metropolitan Hospital using EOQ model?

## 1.5 Justification of the Study

Extensive work has been going on in this subject area but mostly focuses on the manufacturing–and production industries. Less research has been done in relation to the health sector. This research could help to bring about a better healthcare provision. Hopefully, the research can help improve the efficiency in the administration of hospitals by cutting down cost of operations most especially on drugs.

## 1.6 Methodology of the Study

The data for the study was collected from Cape Coast Metropolitan hospital. The secondary sources of the data include inventory reports from the hospital and other sources such as published materials in libraries, journal articles and papers from the internet that are in line with the topic under consideration.

## 1.7 Limitations of the Study

One major challenge in conducting this study was time constraint. As a result, only one hospital was used as a case study. In addition, enough funds to help in the entire exercise were also not available.

## 1.8 Organisation of the Study

In all, the study was organised into five chapters. Chapter two follows which deals with the literature review on inventory management and chapter three involves the methodology of the research and profile of the study area. Chapter four covers the presentation and analysis of the data collected from the field and the fifth chapter contains the research findings, recommendations and conclusions.

# CHAPTER TWO

# REVIEW OF LITERATURE

## 2.0 Introduction

The literature review considers relevant studies made on the subject matter and makes clear how good inventory management practices affect healthcare.

## 2.1 Definition of Inventory Management

Inventory management is an attempt to balance inventory needs and requirements with the need to minimize costs resulting from obtaining and holding inventory. According to Chase et al (2004), "inventory is the stock of any item or resource used in an organization." Inventory management can be interpreted as the avoidance of over investment or under investment in inventories as an essential step in improving overall operational efficiency. Inventory management seeks to maintain stock levels at regular interval by counting and validating the stock at the same intervals, and by comparing the two sets of figures to feedback warming of variances. Sharma (2006) thinks inventory management is concerned with planning, acquisition and flow of materials within the supply chain. Inventory management is the active control program which allows the management of sales, purchase sand payments (http://www.inventorymanagement.com). Considering the definitions given, the researcher therefore defines inventory management as managing the parts or stocks of materials in any form inside the organization and stabilizing the flow of materials considering the variability in demand. Inventory management has often meant too much inventory and too little management or too little inventory and too much management. Every organization holds some things in stock. Stock can be nuisance, a necessity, or a convenience (Monczka et al 2010).In the early 1906s, it was recognized as transactional,

that is "just-go-and-buy". It was not until after the First World War (1914-1918) that the importance of obtaining raw materials and other supplies needed to keep factories and military operations become very crucial. In Ghana, much attention has not been given to supply chain management activities in both the private and government organizations. It was perceived as more clerical to the extent that inventory which is very critical in the supply chain structure was regarded as a punishing outfit where non-performing or even not too qualified personnel were posted (Amoah and Yeboah, 2011). Inventory management is an indispensable core activity of all types of organizations. Organizations are continuously involved in procurement, storage and stock replenishment of different types of stock. According to Sharma (2006), in some industries the cost of materials input ranges between 45% to 85% of the product cost, thus the slightest efficiency in the materials management releases substantial gains to the organization in terms of cost and capital requirement. Among other socio-economic priorities, health is one of the issues that are at the forefront of the Millennium Development Goals (MDGs), which Ghana hopes to fulfil by 2015. The Government therefore prioritised health issues within the MDGs, three of which deal with health issues. These facts therefore make out a strong case to study inventory management with the objective to improve operating efficiency and reduce working capital lock up. In fulfilling such an objective organizations tend to use control systems that monitor levels of inventory and determines what levels should be maintained, when stock should be replenished, and how large orders should be. This goes a long way to achieve the overall objective of inventory management which is to maintain stock levels so that the combined costs, ordering cost, holding cost, stock out cost are at a minimum.

Inventory control is the activity which organizes the availability of items to the customer. It coordinates the purchasing, manufacturing and distribution functions to meet the marketing needs. This role includes the supply of consumables, obsolescent items (Wild 2002).

Wild (2002) adds that the purpose of the inventory control function in supporting the business activities is to optimize the following three targets;

- Customer service
- Inventory cost
- Operating cost

The most profitable policy is not to optimize one of these at the expense of others. The inventory controller has to make value judgments. If profit is lacking, the organization goes out of business in the short term. If customer service is poor, then the customers disappear and the organization goes out of business in the long term. Balancing the financial and marketing aspects is the answer. The first target, customer service, can be considered in several ways, depending on the type of demand.

The second target, inventory costs, requires a minimum of cash tied up in stock. This has to be considered carefully, since there is often the feeling that having stock in stores for a few months is bad practice. In reality minimizing the stock usually means attending to the major cost: very low-value items are not considered a significant problem. Low inventory can also be considered in terms of space. Where the item is voluminous, or the stores space restricted, the size of the items will also be a major consideration.

The third target, avoiding operating costs, has become more of an issue as focus has been placed on inventory management. The prime operating costs are those associated with the stores operation, inventory control, purchasing and associated services. According to Lucey (2002), there are two main inventory control systems being the periodic review system and the two-bin system which are discussed below.

The two-bin system is often called the constant re-order level system. A periodic re-order level is set for each item. When the stock level falls to the re-order point, a replenishment order is issued. The replenishment order is invariable the EOQ. The name 'two-bin-system' comes from the simplest method of operating the system whereby the stock is segregated into two bins. Stock is initially drawn from the first bin and a replenishment order issued when it becomes empty. Most organizations operating the re-order level system maintain stock records with calculated re-order levels which trigger off the required replenishment order.

The periodic review system is also called the constant cycle system. Stock levels for all parts are reviewed at fixed intervals, for instance every fortnight where necessary replenishment order is issued. The quantity of the replenishment order is not a previously calculated EOQ, but is based upon; the likely demand until the next review, the present stock level and the lead time. The replenishment order seeks to bring stocks up to a predetermined level. The effect of the system is to order variable quantities at fixed intervals as compared with the re-order level system.

Inventory management is primarily about specifying the size and placement of stocked goods. The scope of inventory management also concerns the fine lines between

replenishment lead time, carrying cost of inventory, asset management, inventory forecasting, inventory valuation, inventory visibility, future inventory price forecasting, physical inventory, available physical space for inventory, quality management, replenishment, returns and defective goods and demand forecasting. (http//:www.inventorymanagement.com). A good inventory control system offers the following benefits:

The proper relationship between sales and inventory can better be well maintained .Without inventory control procedures in place, the store or department can become overstocked or under stocked.

Inventory control systems provide a business with information needed to take markdowns by identifying slow-selling merchandise. Discovering such items early in the season will allow a business to reduce prices or make a change in the marketing strategy before consumer demand completely disappears.

Merchandise control systems allow buyers to identify best-sellers early enough in the season so that re-orders can be place to increase total sales for the store or department.

Merchandise shortages and shrinkage, can be identified using inventory control systems. Excessive shrinkage will indicate that more effective merchandising controls need to be implemented to reduce employee theft or shoplifting (Clodfelter, 2003).

Inventories are common to manufactures, retailers, wholesalers, hospitals, universities, local governments and a host of other organizations. This indicates how inventories are important and deserve a serious attention especially in our health centres in order to achieve organizational objectives. Supply chain is the life-blood of a healthcare organization. As

most departments depend heavily on supplies, materials management can ease or cramp a hospital's operations. From a low cost needle to a high-end to orthopaedic implant, micro steel instruments or pieces of linen, supplies are indispensable during a patient's stay at the hospital.

Gourdin (2001) identified some activities in order to improve inventory management. These provide some background information on the improvement of inventory management in organizations.



Top management: Because lower inventories have an impact on many different part of the logistics systems, senior leadership must ensure that all of those activities are working together to meet customer needs without the luxury of excess stock.

ABC analysis of all inventory items: Management must first understand that goods in inventory are the most important in terms of their contribution to the objectives of the organization. Those few items that help generate the most profits, for example, or are deemed mission-essential by the organizations would be designated "A" items and perhaps maintained at 100% availability. The bulk of the goods in inventory would be denoted "B" items that might be supported at, for instance 80% levels. Finally there could be some low-demand items classified as "C" which are maintained at very low levels or not possibly stocked at all.

Improved performance of other logistics activities: Manager should ensure that the rest of the logistics system is functioning efficiently. It may be that inventory policies have evolved as a way to obscure other problems that should be dealt with directly. By reviewing transportation, order processing and warehousing functions, for example management may

find that order-cycle variability can be reduced by improving those activities that would lower the need for inventory.

Improved demand forecasting: Demand forecasting is also a way of reducing variability, this time in terms of expected versus actual demand. Better forecasting techniques can be utilized to that effect. In this case management needs to know common diseases which are frequently reported which would obviously translate into the demand for those supplies.

Inventory management software: Software is currently available for virtually any type of inventory management situation. For instance the Smart Turn Inventory and Warehouse Management System for healthcare institutions eliminates manual data entry, paper files, and forms by automating records and other documents that determine how and where medical inventory is received, stored, and used.

As seen earlier inventory management aims to balance inventory needs and at the same time minimize all cost incurred as a result of obtaining inventory. Whether as a deliberate policy or not, stock represents an investment by the organization. As with any other investment the costs of holding stock must be related to the benefits to be gained. The drawback of holding excess stock is the effort it has on a firm's working capital. Buying inventory and storing carries with it some cost therefore excess inventory ties up working capital that could be used much productively.

In this era of credit crunch all organizations needs working capital to roll out its development plans. There are therefore four categories of cost associated with inventory which the concept of inventory management seeks to control (Monczka et al, 2010; Lucey,

2002). Obviously, when these costs are able to be managed, the efficiency of these hospitals could be improved through the cutting of down of operational cost.

The unit cost or cost of stock is the direct costs of production. The unit cost appears in several forms. Each item that is purchased from a supplier has a unit price and it is that which is paid to the supplier. Secondly with items that are produced internally, the unit price is the cost of production. This is normally difficult to calculate because it would cover raw material used in the production, labour costs, opportunity cost etc. This cost needs to be considered when discounts are available for bulk purchase and also when savings in production costs are possible with longer batch runs.

The procurement cost sometimes known as ordering cost refers to clerical and administrative costs associated with the purchasing, transport cost, receipt, quality checks and any other cost associated with an order. However when goods are manufactured internally the ordering cost includes equipment set up cost, tooling costs, preparation, production planning etc:

The holding cost also known as carrying cost is a form of cost which includes storage charges which would have to do with rent, lighting, refrigeration etc., interest on capital invested in the stock, insurance, stores staffing, stock taking or perpetual inventory cost etc. Monczka et al (2010) summarizes holding cost into three main components. Financial cost which is primarily for the capital tied up. Maintenance cost such as providing the right conditions, insurance, deterioration and lastly providing the storage, administration systems etc. Holding costs are typically around 20 percent of the value of the inventory but varies widely with the cost of capital (Bowerosx and Closs, 1996 cited in Monczka et al, 2010).

Total holding cost is the average number of units held x unit price x holding cost per year. For instance if a firm averages 5000units in stock, and the unit Price is GH¢10 and the annual holding cost is 30 percent of value. Then the total carrying cost is (5000 x 10 x 0.3) = GH¢15000.

Shortage or stock out cost is the kind of cost incurred when stocks run out and are not available when needed. Stocks are normally held by a company to avoid this cost. The components of shortage cost include loss of customer goodwill, labour frustration over stoppage, loss of future sales because customers go elsewhere, lost contribution through the lost sale caused by the stock out. Most of these costs are very difficult to quantify but nevertheless are very important. Taking steps to avoid some of these costs could have some money for operational activities. For example when manufactures run out of raw materials there can be very high cost for shutting down production and operations came to a standstill. Essentially, organizations are willing to incur the cost of holding stock to avoid the even higher costs of shortages (Waters 2003).

## 2.2 Healthcare

Health care is the diagnosis, treatment and prevention of disease, illness, injury, and other physical and mental impairments in humans. Health care is delivered by practitioners in medicine, chiropractic, dentistry, nursing, pharmacy and allied health. The exact configuration of health care systems varies from country to country, but in all cases requires a robust financing mechanism; a well-trained and adequately paid workforce; reliable information on which to base decisions and policies; and well maintained facilities and logistics to deliver quality medicines and technologies (http//:en.wikipedia.org/wiki/Health-care). In the area of health care, the public and private sectors are important stakeholders

with the public sector organized according to national (2 teaching hospitals), regional (10 regional hospitals), district (281 district public and other hospitals), sub-district (622 public health centres) and community about 1658 Community Health Planning Service and maternity homes at the community level (Ghana Health Service, 2005).

## 2.3 Inventory Management in Healthcare

Hospitals are in the business of serving patients. Successful patient care requires that the right supplies are delivered and available at the right time. Maintaining and distributing medical inventory can take up a large portion of medical staff and technician's time. It is important for all staff, regardless of scheduling and shifts, to access, supervise, and perform medical inventory orders. This can assure proper inventory levels, access, and tracking so your professionals can concentrate on patient care. Managing inventory in hospitals has long been an important task, yet it is often overlooked in the busy environment. By initiating a program that utilizes barcodes, hospitals can control inventory supply areas with ease, as well as keep track of all equipment in use across the enterprise.

Inventory functions can basically be broken down into two separate categories: stockroom applications and check in/checkout applications. Stockroom inventory applications track consumable items e.g., medication and supplies, while check in/out applications track shared or re-usable items e.g., X-rays, diagnostic tools, and other medical equipment

(www.barcoding.com/industry/healthcare/hospitals.shtml.Materials management plays a crucial role in providing efficient healthcare by touching three vital aspects of medical supplies used in the hospital which are availability, safety and affordability

(http//:www.asianhhm.com/knowledge_bank/articles/materials-management-healthcare.html).

### 2.3.1 Timing: the most crucial aspect

The time factor is probably not as crucial in any other field as it is in healthcare delivery where delay of a few seconds can cost a life. Moreover, availability of a low cost catheter is as critical as a high value pace maker when it comes to medical care. Therefore, inventory managers have the huge responsibility of making thousands of diverse medical consumables available on time. The challenge is even greater as the number of expected patients are unpredictable; suppliers are unreliable and costs are rising. With recent developments in automation and information technology and emerging trends in the medical supplies industry, materials managers are now better equipped to handle time constraints.

An effective Materials Management Information System (MMIS) provides features such as re-order levels that can help in automatic replenishment of items. Once the orders are placed, delivery schedules can be closely monitored with the help of an on-line tracking system. This creates better control of medical inventory and the policies and procedures that are related to managing your inventory levels. Continuous follow-up instils a sense of discipline in vendors and makes them adhere to the timelines specified in the purchase order. Purchasing and receiving details can be used for allotting and updating vendor ratings. Regular defaulters can be dropped from the 'approved vendors' list thus improving the reliability quotient of suppliers. Minimum levels can be set up to safeguard against stock outages. Access to online inventory helps in confirming the availability of an item for a scheduled procedure. Emergencies can be managed more effectively by moving excess supplies to areas where there is a spike in demand.

RFID technology, which is rapidly replacing bar-coding, is another effective way of tracking expensive medical devices and improving availability. Use of Point-of-Service (POS) readers for capturing usage improves the accuracy of billing and clinical documentation. Access to real-time information helps in improving service levels; maintain optimal inventory and saving cost.

### 2.3.2 Patient safety-the first priority

The safety of patient is the top priority in healthcare, and materials managers play a crucial role in protecting his / her interest. The biggest responsibility of a materials manager is to ensure that the products purchased for clinical use are of good quality. It can be achieved by developing a 'product evaluation' system consisting of well-defined parameters to guarantee that only approved products enter a hospital's stockroom.

Despite cost being an important criterion in assessing new products, safety and clinical efficacy concerns are prioritised. Physicians should be consulted to help determine if a new product is performing and producing desired clinical impact. Another effective way of determining the safety of a product is to check for FDB approval. The vendor's access needs to be restricted and back door sales discouraged to ensure that only properly reviewed products are brought into the facility.

Materials managers need to take initiative in organising hands-on training for caregivers to ensure safe use of complex and critical equipment like laparoscopic graspers, staplers and arterial filters. Absence of proper training can result in patient injury leading to serious medico-legal issues. Training programmes conducted by experts can be held either in-house or at specially designed state-of-the-art institutes equipped with ergonomically designed

simulation labs and conference halls with telesurgery facilities. In many instances, clinical outcome improves with the use of advanced techniques and hence regular training should be encouraged.

Materials managers also need to ensure that stocked products are well within the expiry period. Any good MMIS can provide list of items expiring within a given date range. Items that cannot be utilised in their current location before the stipulated expiration date can be moved to high consumption. Rotating short expiry products helps ensure patient's safety.

Appropriate storage is another critical aspect that affects the efficacy of medical supplies and the quality of treatment. Medical supplies are temperature sensitive, so it is imperative to store them cautiously at all points of the distribution chain wherein, any slackness may lead to serious safety concerns. Sutures can break off resulting in post-surgical complications and laboratory reagents can give misleading results for a critical diagnostic test, if not stored at proper temperature.

### 2.3.3 Cost - An important variable

There is tremendous pressure on materials managers to initiate serious cost cutting measures. While the cost of medical supplies has been spiralling up, greater numbers of patients are demanding high quality and reasonably priced healthcare services. Since cost of supplies forms a significant portion of healthcare expense, materials mangers should continuously strive to get better deals. Economical prices help ensure affordable medical care for vast majority. The healthcare organisation in turn reaps the benefit of better revenue realisation stemming from increased number of patients.

While the prices available to an organisation are influenced by the purchasing volumes, negotiation skills of the purchasing personnel also play an important role. Knowledge of competitive products, awareness of current market trends and capability to use the database for price/volume information helps tremendously in the bargaining process. Other sources for product related information, including regulatory issues are product fairs and conferences, internet articles and periodicals.

Collaborative relationships with clinicians and networking with other hospitals and vendors can help in keeping abreast with latest products and upcoming technological trends. Such close and continuous interaction also gives important clues about non-performing products. Instituting an efficient system for payables is effective in getting rebates and discounts, which can be passed on to the patient.

The medical supplies industry is flooded with innovative products and services. Materials managers should continuously scout for competitive alternative product or techniques that can give better outcome. While cost is an important criterion, quality of the product needs to be the primary concern to ensure that patient care is not compromised.

### 2.3.4 Driving Healthcare Efficiency

For health care organizers such as hospitals, inventory control is an important management function. These providers must carefully manage inventory to ensure their operations run efficiently and effectively. Health care inventory is also an expense, which means organizations may find it difficult to replace inventory that is lost, stolen or damaged. Additionally, health care organizations must have certain items on hand in order to complete

medical services, requiring them to maintain an inventory budget. A manager is typically responsible for inventory control, which can offer some advantages to these organizations.

Waste reduction: For hospitals seeking to reduce waste, it is essential to improve the supplies management processes. Studies have shown that the level of waste (obsolescence, expiry, damaged, special need duplicated) is generally around 20% of all items on hand – with a further 25-30% of on hand stock in excess of requirements and therefore at greater risk of becoming obsolete, expiring or being damaged. Efficiently identifying and managing supplies within and to the hospital will help to reduce waste, increase profits and improve process management (www.sentinthealth.com/en/casestudies.php)

Theft Prevention: Theft prevention is an important feature of inventory control in health care organizations. Not only are many inventory items expensive, but they are also dangerous if an employee attempts to steal drugs or medication. Health care organizations typically store inventory in locked rooms with limited access. This helps reduce theft or abuse by employees and other individuals. Managers may also be the only individuals allowed to order inventory, which reduces abuse in the procurement process.

Reduce Errors and Issues: Health care organizations must be extremely careful with inventory items because they can cause undue damage or harm to people. During surgeries, doctors can use several medical instruments. Failing to track these items on completion of the surgery can result in lost equipment. Organizations must also be able to adequately dispose of used inventory items. Proper disposal ensures that individuals will not risk exposure to deadly communicable diseases commonly found in health care organizations.

Cost Control: Inventory controls can help health care organizations reduce their operating costs. Many organizations often work from a budget, which helps their company maintain low, unnecessary inventory expenditures. Constantly replacing lost or stolen items can quickly increase costs and become an additional expense for paying customers. Organizations may need to implement an automated software application or barcode system which can track inventory electronically. These systems can improve inventory control and provide long-term cost reduction benefits.



### 2.3.5 Successful Healthcare Inventory Control

Efforts to improve cost effectiveness and efficiency are continuously underway in clinical departments, as financial pressures faced by hospitals continue to mount. Having experienced the pressures that comes with poor inventory control, the vascular radiology division at Boston's Massachusetts General Hospital needed some high-tech solutions. MGH's vascular radiology department had to maintain a large array of equipment, supplies and devices to accommodate its wide variety of patients and attendant pathologies. Historically, this division grappled with expired stock, insufficient space for existing stock, "bulk" purchasing patterns to achieve savings, a high incidence of unused inventory and virtually no operational data to examine utilization patterns. Monitoring inventory levels and ordering supplies was a labour-intensive process, and low-level supplies often weren't identified in time. The hospital needed effective inventory management to focus on the front end. In October of 2000, the department implemented an inventory management program that enabled the staff to solve these problems. This program uses an automated, online patient and inventory tracking system sponsored by the Society of Cardiovascular and Interventional Radiology. With the system, a centralized database maintains patient

demographic information and procedure-specific encounter data, including services provided, operators, inventory utilization, and billing and coding data. The program resides on either a centralized PC that uses handheld computers to gather data, or on a PC. Following system installation, all staff including physicians, technologists, nurses and support staff underwent mandatory on-site training and education. This automated and dynamic inventory tracking helped the division realize a $150,000 supply budget savings for fiscal year 2001. With effective inventory management, management could now balance the needs of product availability to maximize patient care with efficient financial management (www.hi-iq.com). The University of Iowa Hospitals and Clinics is also an example of a hospital that has been successful on adopting proper inventory management practices. Manual methods were being used to keep track of the extensive inventory of medical devices and supplies. They were relying on visual checks, physical counting, and a paper message system to keep track of over 1,300 different items. And there was no way to track expiration dates. With such a large inventory, it was simply impossible to stay on top of everything and make sure they had exactly what each physician needed. The first response was to overstock because they don't want to run out of something. With 769 beds, UI Hospitals and Clinics serve as the teaching hospital and comprehensive healthcare centre for the state of Iowa. More than 41,000 patients are admitted annually. Staff with the duties of maintaining inventory on many occasions, would stay late to examine inventory and complete the paperwork needed by the purchasing department for reorders. Similarly, each budget cycle required tedious attention to paper records and the development of a spreadsheet to calculate usage history and make projections for the coming year.

Management determined to find a better way to manage inventory, implemented a card out system which operated like the reminder slip in a box of bank checks. They put cards with the product information into the supply storage units at predetermined points. When a technologist reached the card, it would be put on the inventory officer's desk, triggering a reorder. Though not particularly sophisticated, the system helped reduced the amount of excess inventory and provided enough evidence that a more advanced inventory tracking system might provide greater reductions and cost savings,

(www.cathlabdigest.com/article/2570).



## 2.4 Profile of Cape Coast Metropolitan Hospital

### 2.4.1 History of Cape Coast Metropolitan Hospital

Cape Coast Metropolitan Hospital is located at the Cape Coast Metroplois in the Central region of Ghana. It is bounded on the South by the Gulf of Guinea, on the West by St. Augustine College and on the East by the Cape Coast NTC and on the North by Fosu Lagoon.

The Cape Coast Metroploitan Hospital was established in 1939 as a district hospital and later upgraded to a Rgional Hospital for Central region. In 1998, when the new Regional Hospital was built, it was reverted tot he district hospital status. The hospital serves about 106 communities.

The hospital has One hundred and fifty beds (150) with five (5) wards namely: Paediatrics ward, Male ward, Female ward, Obstetrics and Gynaecology ward and Isolation ward. In addition to this, the hospital has OPD as well as Emergency/Casualty unit which run 24

hours services. The Casualty unit takes care of emergency cases like minor surgeries and detain cases for observation while the OPD takes care of general reported cases. The hospital has one big theatre with changing rooms for Medical Officers and nurses, two operaating rooms: one for minor and septic cases and the other for major cases, etc.

The hospital has the following technical and diagnostic units: Pharmacy, laboratory, mortuary, x-ray unit and Ultrasound scanning unit.

There are also administrative and support units which include: General Administration, Accounts, Biostatistics unit, Stores and Supplies, Laundry, Security, Catering, Maintenance unit, Telephone Exchange unit, Environmental and Transport units.

In addition to these medical services, health talks are also given to patients by some selected staff of the hospital before consultation.

The common cases seen at the hospital include malaria, diseases of oral vavity, upper respiratory tract infection, gynaecological disorders, acute eye infections, diseases of the skin, pregnancy related complications, etc. Most surgical and gynaecological cases are performed at the hospital except ffew cases that are referred to the Central Regional Hospital.

The Extended Service Area includes surrounding communities such as Bakaano, St. Augustines College, Ola community, Elmina etc., which total up to about 87934 which was OPD attendance for 2011. The total OPD attendance in 2011 increased as compared to 2010 and 2009 figures with each representing 73164 and 83585 respectively. The increase may be as a result of the opening of the new unit (herbal medicine unit), the renovation of OPD,

maternity, family planning units and opening of sick bays in various second cycle institutions in Cape Coast.

### 2.4.2 Mission

Cape Cost Metropolitan Hospital that provides quality health services through highly skilled, well-motivated and client oriented staff to people in Cape Coast Metropolis and its environs.



### 2.4.3 Vision

Excellence through Quality Health Service

### 2.4.4 Objectives

- to provide prompt and proper treatment and education to people who access our services.

- To ensure efficiency in all areas of operation.

- To provide needed skills and good working conditions for all staff.

- To ensure effective collaboration with all stakeholders

- To use state of the art technology to enhance efficiency in service delivery.

### 2.4.5 Hospital Management Team

- Director: He is in-charge of the Hospital as well as the Health Services of the whole.

  He is responsible to the Regional director.

- Hospital Administrator: He is responsible for the day-to-day management of the Hospital. He assists the Director to manage the hospital. He is responsible to the Director.

- Senior Nursing Officer: The Chief Nursing Officer is responsible for the Nursing Activities in the hospital. She supervises the Nurses and Anaesthetists. The Senior Nursing Officer is responsible to the Director. Functionally, the Director, Administrator and the Senior Nursing Officer form the typical tripartite management committee which runs the hospital.

- Pharmacist

- Accountant

### 2.4.6 Health Care Services

The hospital provides general medical services in the following area:

- Medicine
- Surgery
- Social welfare
- Obstetrics and Gynaeclogy
- Dentistry
- Public health services which includes Antenatal and Postnatal services
- Eye Clinic
- HIV counselling and testing
- Community psychiatric clinic

- Diabetic clinic
- Family planning clinic

The list in the table shows the services that are offered at the hospital

**Table: 2.1 Services offered at the Hospital**

| | |
|---|---|
| Out-Patient Department | Laboratory |
| Accident and Emergency | Surgery |
| Maternal Care | Obstetrics and Gynaecology |
| Institutional Pharmacy | Public Health |
| Radiography (X-ray & Radiology) | Dental Care |
| Ultrasound Scanner | Voluntary Counselling Testing (HIV/AIDS) |
| In-Patient Services | Occupational Health |
| Eye Care | |

**Source: Cape Coast Metropolitan Hospital Administration, 2012**

### 2.4.7 Values

In pursuing its vision and mission, the Cape Coast Metropolitan Hospital will be guided by these hallmarks

1. Dedication
2. Hardworking
3. Discipline

# CHAPTER THREE

# METHODOLOGY

## 3.0 Introduction

This chapter describes the methods used when conducting the thesis. Research purpose, research approach, research method and strategy are first presented. Data collection process, analyse approach and finally quality criteria ends this chapter.

## 3.1 Research Approach



The two research approaches, the quantitative and the qualitative, have several differences (Saunders et al., 2000). A qualitative approach means that you use words to describe and explain the reality. It is an approach that claims that you should examine a world by examining how the inhabitants look at this world. In this type of research, theory should be a result from the study and not a condition for it. Criticism that is directed towards the qualitative approach is that the researchers view and opinion will affect the result from the collected data and one will not get an objective view but a subjective. It is almost impossible for a researcher not to affect the people that he is interviewing, which mean that two different researchers might get two different results from interviewing the same person (Bryman and Bell, 2003).

In a quantitative approach, the researcher plays the role of an objective analyst that is not influenced by the object of the research (Saunders et al., 2000). The quantitative approach represents the structured way of approaching the research subject. This leads to standardized interviews from where it is easy to generalize the results (Holme and Solvang, 1991).

The conclusions and the result of the thesis are preferably made on hard data i.e. demand, stock levels, unit cost, etc. of essential drugs kept at Cape Coast Metropolitan Hospital. The thesis has both a qualitative and quantitative approach.

There are two main contradicting research strategies in scientific work; these are reflected to the use of theory. These two methods are called deductive and inductive. Backman (1998) defines the inductive method as approaches that strongly interact with empirical studies from which research questions and hypothesises are formulated. The deductive is based on theory and then tests the theory in reality. The quantitative research approach is predominately inductive and hypothesis generating. The more traditional quantitative research approach is often deductive and hypothesis testing (ibid). It is however possible to combine the two methods in researches according to Saunders et al. (2000).

By observing and analysing the inventory management practices at Cape Coast Metropolitan Hospital in general, the author formulated the research questions. This was followed by literature studies and the relevant theories were tested on Cape Coast Metropolitan Hospital inventory management practices.

## 3.2 Research Design

A case study design would be used for the study. Case studies are preferred when the researcher want detailed and thorough information and analyses in individual cases. It is suited for a explorative research where you want to get a detailed understanding of processes of different kind and where you do not know in advance what is important to examine. Because the number of the underlying material is small it makes the option to

generalize the results of the observations limited (ibid). The case study for this study is Cape Coast Metropolitan Hospital with focus on the inventory management of essential drugs.

## 3.3 Population of the Study

The term population means the total number or aggregate of concern which by virtue of common characteristics may lead to access to relevant information. This study focused on the application of the Economic Order Quantity (EOQ) model on essential drugs kept at the Cape Coast Metropolitan Hospital. Hence, the total drugs in stock at the hospital are about two hundred and forty-eight (248). For the case of the study 50 drugs were selected.

## 3.4 Basic Economic Order Quantity Model (EOQ)

Economic order quantity is the level of inventory that minimizes the total inventory holding costs and ordering costs. It is one of the oldest classical production scheduling models. The framework used to determine this order quantity is also known as Wilson EOQ Model or Wilson formula. The model was developed by F.W. Harris in 1913 but R.H. Wilson is given credit because he applied it extensively (Mishra 2007). The EOQ is of great importance for those organizations which purchase or manufacture goods in bulk because of its relative sample analysis which bring out the nature of the faced trade-offs that must be used in any inventory system. EOQ applies only where the demand for a product is constant over the year and that each new order is delivered in full when the inventory reaches zero.

There is a fixed cost charged for each order placed, regardless of the number of units ordered. There is also a holding cost for each unit held. We want to determine the optimal number of units of the product to order so that we minimize the total cost associated with the purchase, delivery and storage.

### 3.4.1 EOQ Model Assumptions

The EOQ has been previously defined as the ordering quantity which minimizes the balance of cost between inventory holding costs and re-orders costs. To be able to calculate a basic EOQ certain assumptions are necessary and according to (Reid and Sanders ,2007) they are as follows

Demand is known and constant and safety stock is required

Lead time is known and constant

No quantity discounts are available

Ordering (setup) costs are constant

All demand is satisfied (no shortages)

The order quantity arrives in a single shipment



### 3.4.2 Annual ordering cost

According to Lucey (2002) the annual ordering cost is the number of orders placed per year x cost of placing an order. The number of orders placed in a year is a fraction of the order size. Total annual ordering cost is $\left(\frac{D}{Q}\right)C_o$

### 3.4.3 Annual holding cost

This is the average inventory level x the cost to carry a unit in inventory for a year. Total annual holding cost is $\left(\frac{Q}{2}\right)C_h$

### 3.4.4 Total annual cost

This is the sum of the annual holding and ordering cost and therefore total annual cost is

$$TC = \frac{D}{Q}C_o + \frac{Q}{2}C_h$$

**EOQ occurs when**

$$\frac{D}{Q}C_o = \frac{Q}{2}C_h$$

Algebraically, $Q^2 = \left(\frac{2DC_o}{C_h}\right)$ and finally $Q^* = \sqrt{\frac{2DC_o}{C_h}}$

**EOQ symbols**

Q is for order quantity

$Q^*$ is for optimal order quantity

D is for annual demand quantity of the product

P is for purchase cost per unit

$C_o$ is for fixed cost per order set up cost

$C_h$ is for annual holding cost (also known as carrying/storage cost)

The order quantity (Q) is the variable we want to optimize. The greater Q is, the less we will spend on orders, since we order less often. On the other hand, the lesser Q is the more we spend on inventory (Monks, 1996).

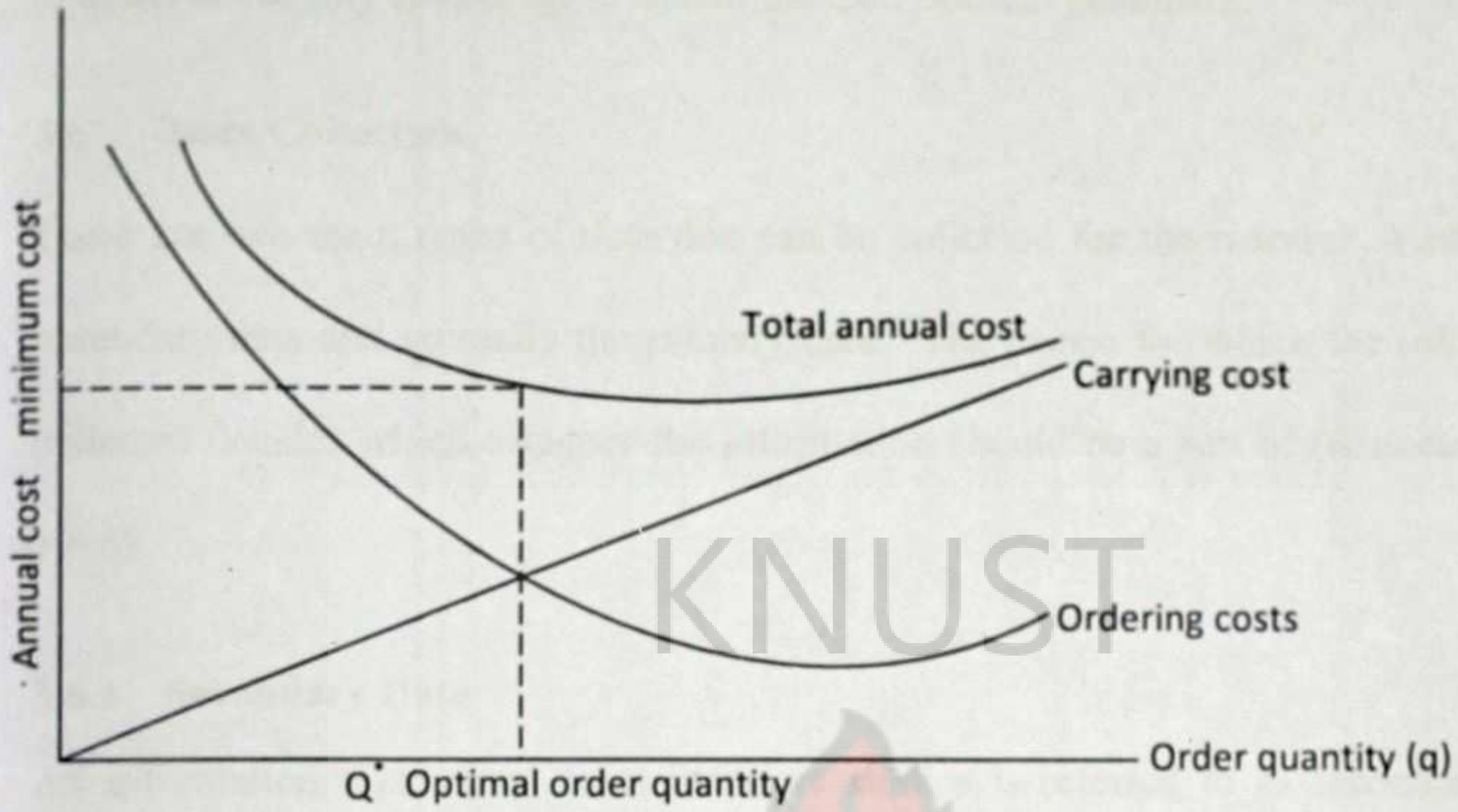


**Figure 3.1 Cost minimization goals**

**Source: Monks (1996)**

## 3.5 Sample and Sampling Techniques

A sample is a group of items taken from the population so that the needed information can be obtained for the purpose of analysis. Considering the largeness of the population involved in this study, the researcher had selected a sample from the population upon which the study was conducted and generalization made based on the assumption that sample is the representative of the whole population.

Since a good sample must be as nearly as representative of the entire population as possible, care was taken in this research to make sample size relatively large in order to convey a

measure of credibility to the outcome of the study. A random sampling technique was used to select about fifty (50) drugs to determine their optimal quantities.

## 3.6 Data Collection

There are two main types of data that can be collected for the research. First there is the secondary data and secondly the primary data. The reason for which the information was collected decides which category the information should be a part of (Kinnear and Taylor, 1996).



### 3.6.1 Secondary Data

All information that comes from literature studies is referred to as secondary data. This means that the information often have been developed for another purpose than actual study at hand. It is important to realise that the data from previous researchers could have been interpreted differently from one's own perception (Kinnear and Taylor, 1996).The secondary data was sought from the Cape Coast Metropolitan Hospital records section and stores.

## 3.7 Data Analysis

Data analysis for this study was done using EOQ inventory model of the Quantitative Method software to determine the optimal quantities for the drugs. Mathematical software called Statistical Package for Social Scientist (SPSS) was therefore used to produce graphs and tables where appropriate to analyse and present the data. As the study sought information on the inventory management practices, qualitative data was analysed explanatorily.

# CHAPTER FOUR

# FINDINGS, ANALYSIS AND DISCUSSIONS

## 4.0 Introduction

Chapter four captures the presentation and analysis of the data. As mentioned in chapter three before, the data was analysed using Quantitative Methods software and SPSS to the analysis of the data collected from the hospital. Data was collected from staff of the hospital whose activities basically concern the managing of inventory. Presentation and discussions are done in alignment with the respective objectives with which it applies.

## 4.1 Calculation of EOQ of Essential Drugs at the hospital

The findings revealed that since the hospital did not have a model for determining the optimal quantity of drugs and other essential health products to be kept, sometimes, it lead to stock out, requisitions for new orders delay and sometimes too, there is late delivery. Therefore, there is the need to apply the Economic Order Quantity (EOQ) model to determine the amount of drugs and essential health materials that would be needed by Cape Coast Metropolitan hospital.

Hence, the EOQ formula was used to estimate the optimal quantity (EOQ) of essential drugs at Cape Coast Metropolitan Hospital as follows;

### 4.1.1 Amlodipine 5mg (Tab)

Annual Demand = 58335.2

Ordering Cost Per Unit = 0.084

Carrying Cost Per Unit = 58335.2/728=80.13

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 58335.2 \times 0.084}{80.13}}$$

$$Q = \sqrt{\frac{9800.3136}{80.13}}$$

$$Q = \sqrt{122.31}$$

Q = 11.06 units

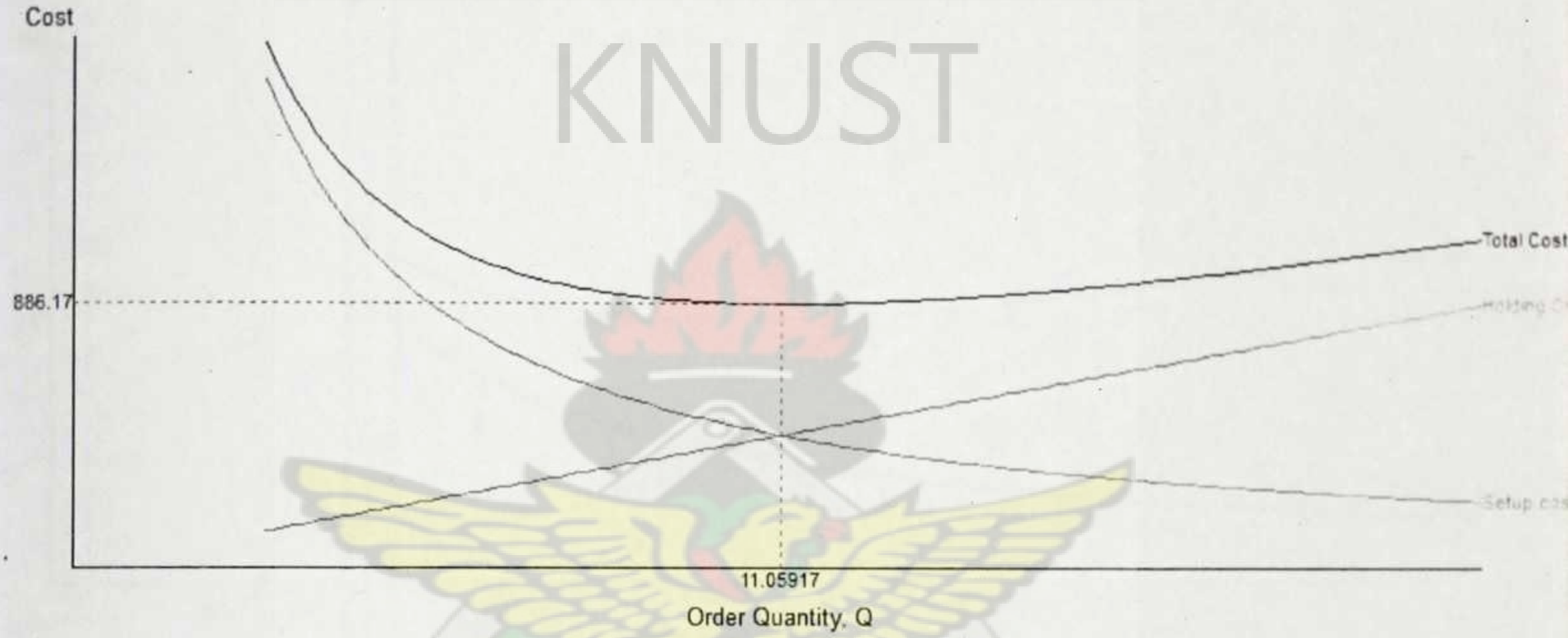


**Figure 4.1 Amlodipine 5mg (Tab)**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Amlodipine 5mg for the year is 11.06 units whereas it will cost the hospital GH¢886.17.

### 4.1.2 Calamine Ointment

Annual Demand = 298

Ordering Cost Per Unit = 0.0172

Carrying Cost Per Unit = 298/728=0.41

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 298 \times 0.0172}{0.41}}$$

$$Q = \sqrt{\frac{10.212}{0.41}}$$

$$Q = \sqrt{25.00}$$

Q = 5 units

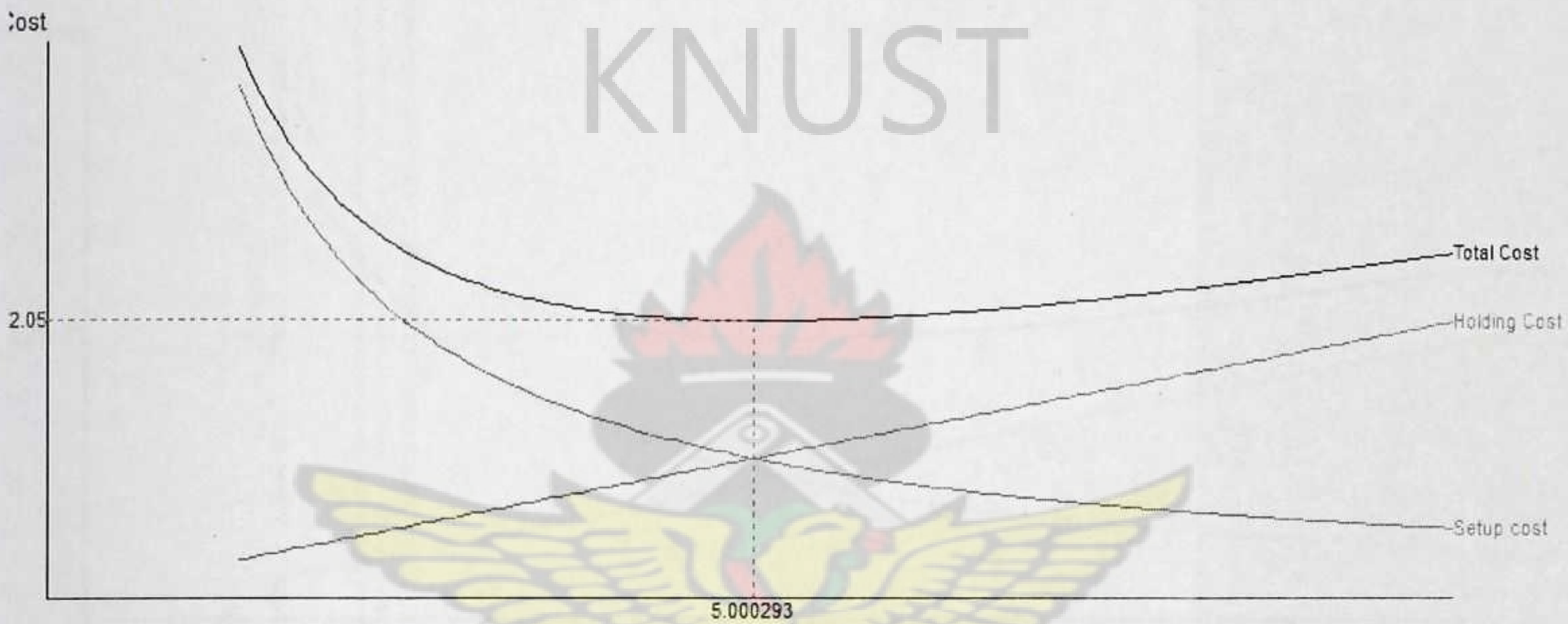




**Figure 4.2 Calamine Ointment**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Calamine Ointment for the year is 5 units whereas it will cost the hospital GH¢2.05

### 4.1.3 Cap Amoxyl (Amoxycillin) 250mg

Annual Demand = 276400

Ordering Cost Per Unit = 0.0278

Carrying Cost Per Unit = 276400/728= 379.67

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 276400 \times 0.0278}{379.67}}$$

$$Q = \sqrt{\frac{15367.84}{379.67}}$$

$$Q = \sqrt{40.48}$$

Q = 6.36 units

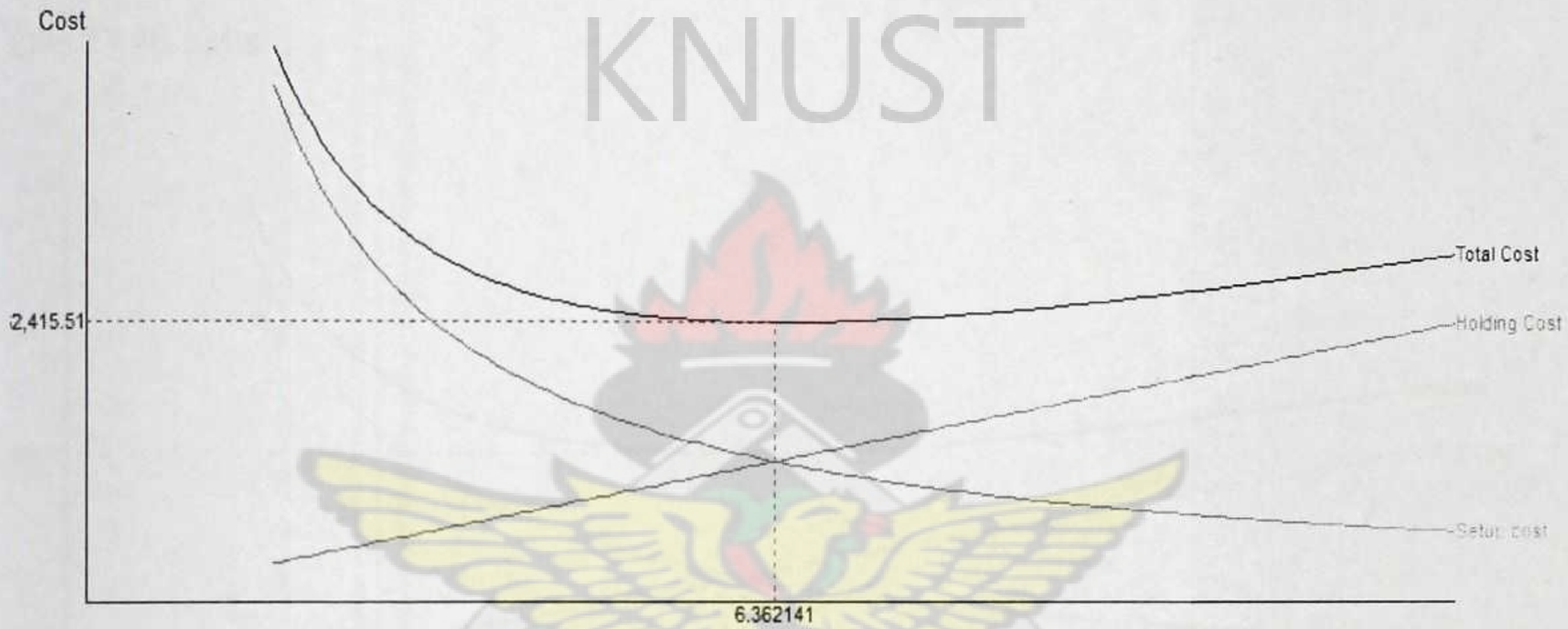


**Figure 4.3 Cap Amoxyl (Amoxycillin) 250mg**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Cap Amoxyl (Amoxycillin) 250mg for the year is 6.36 units whereas it will cost the hospital GH¢2,415.51.

### 4.1.4 Cap Clindamycin 150mg

Annual Demand = 15740

Ordering Cost Per Unit = 0.376

Carrying Cost Per Unit = 15740/728= 21.62

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 15740 \times 0.376}{21.62}}$$

$$Q = \sqrt{\frac{11836.48}{21.62}}$$

$$Q = \sqrt{547.478260}$$

Q = 23.40 units



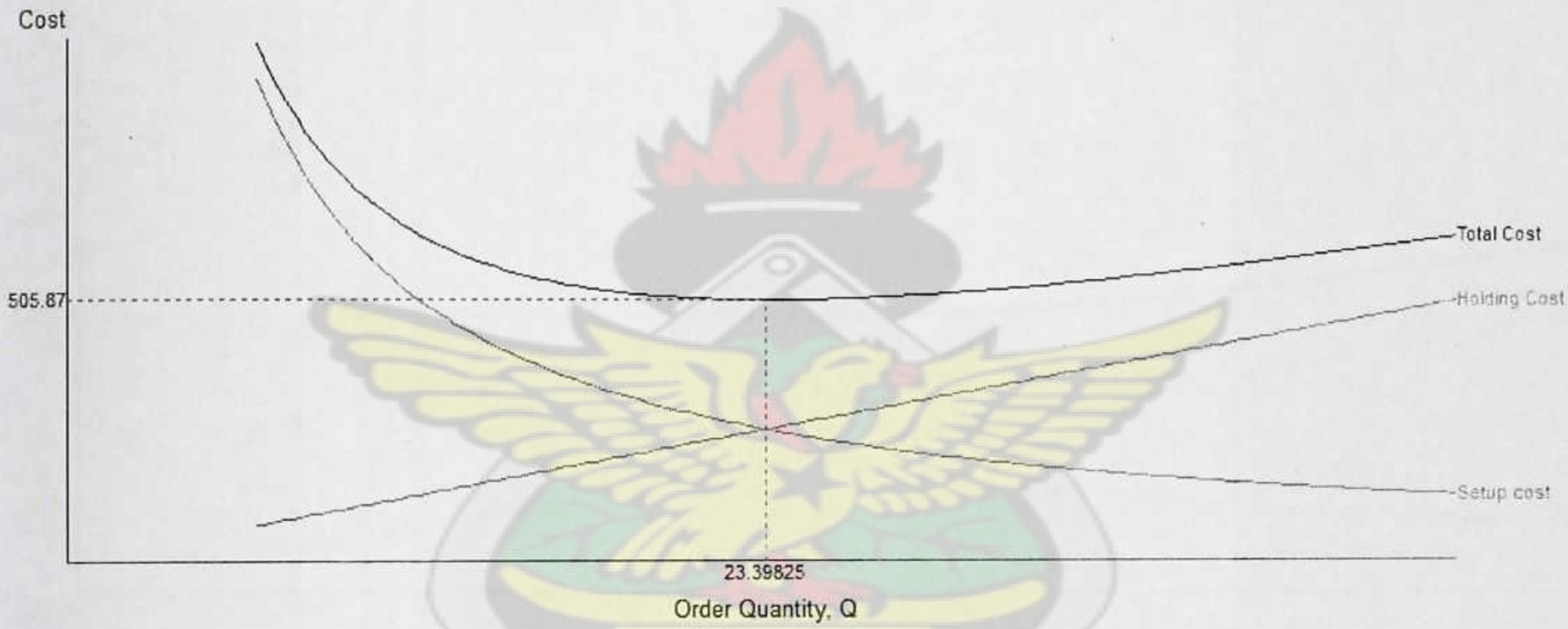


**Figure 4.4 Cap Clindamycin 150gm**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Cap Clindamycin 150gm for the year is 23.40 units whereas it will cost the hospital GH¢505.87.

### 4.1.5 Chlorpheneranine 4mg

Annual Demand = 38400

Ordering Cost Per Unit = 0.275

Carrying Cost Per Unit = 38400/728= 52.74

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 38400 \times 0.275}{52.74}}$$

$$Q = \sqrt{\frac{21120}{57.74}}$$

$$Q = \sqrt{365.7776}$$

Q = 20.01 units



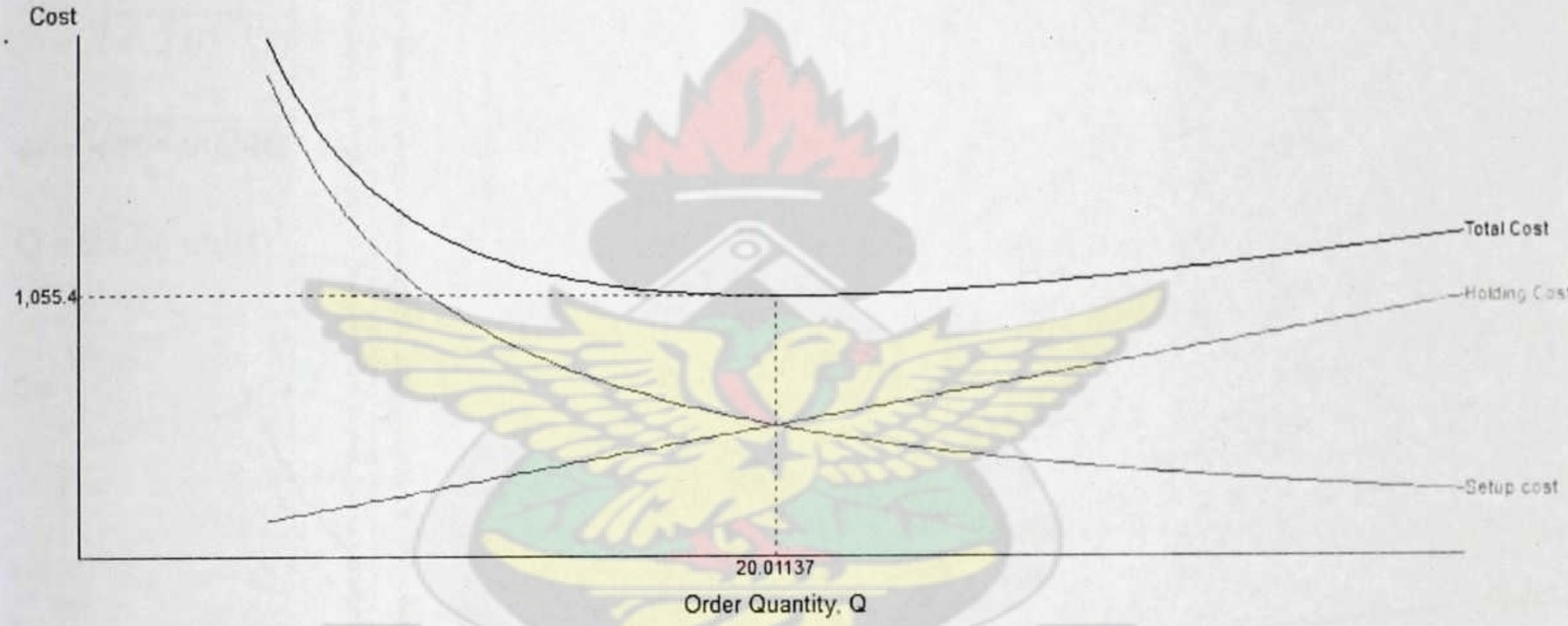


**Figure 4.5 Cap Chlorpheneranie 4mg**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Cap Chlorpheneranie 4mg for the year is 20.01 units whereas it will cost the hospital GH¢1,055.4.

### 4.1.6 Inj. Hydrocortisone 100mg

Annual Demand = 1476

Ordering Cost Per Unit = 0.526

Carrying Cost Per Unit = 1476/728= 2.03

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 1476 \times 0.526}{2.03}}$$

$$Q = \sqrt{\frac{1552.752}{2.03}}$$

$$Q = \sqrt{764.90246}$$

Q = 27.66 units

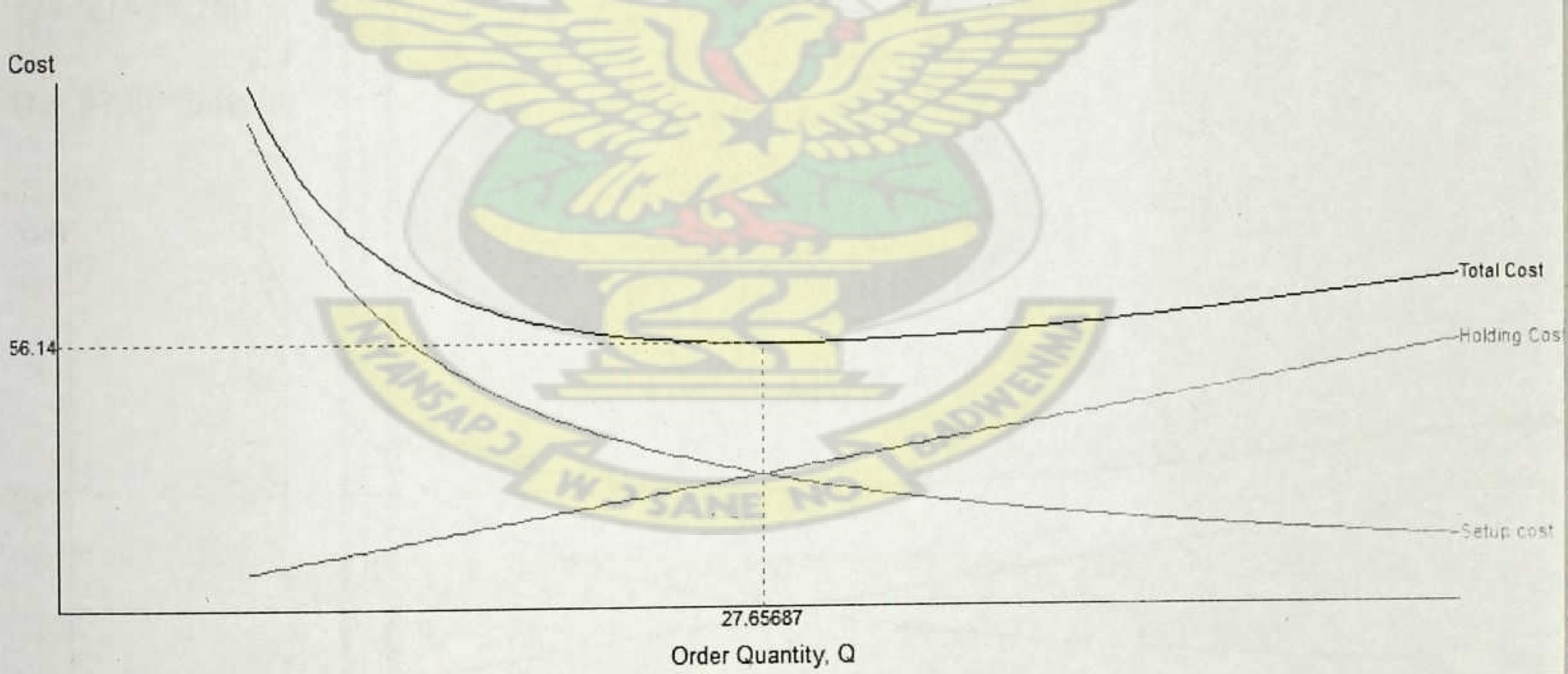


**Figure 4.6 Inj. Hydrocortisone 100mg**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Inj. Hydrocortisone 100mg for the year is 27.66 units whereas it will cost the hospital GH¢56.14.

### 4.1.7 Injuction Pethidins 100mg

Annual Demand = 2160.6

Ordering Cost Per Unit = 0.982

Carrying Cost Per Unit = 2160.6/728= 2.97

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 2160.6 \times 0.982}{2.97}}$$

$$Q = \sqrt{\frac{4243.4184}{2.97}}$$

$$Q = \sqrt{1428.760}$$

Q = 37.80 units

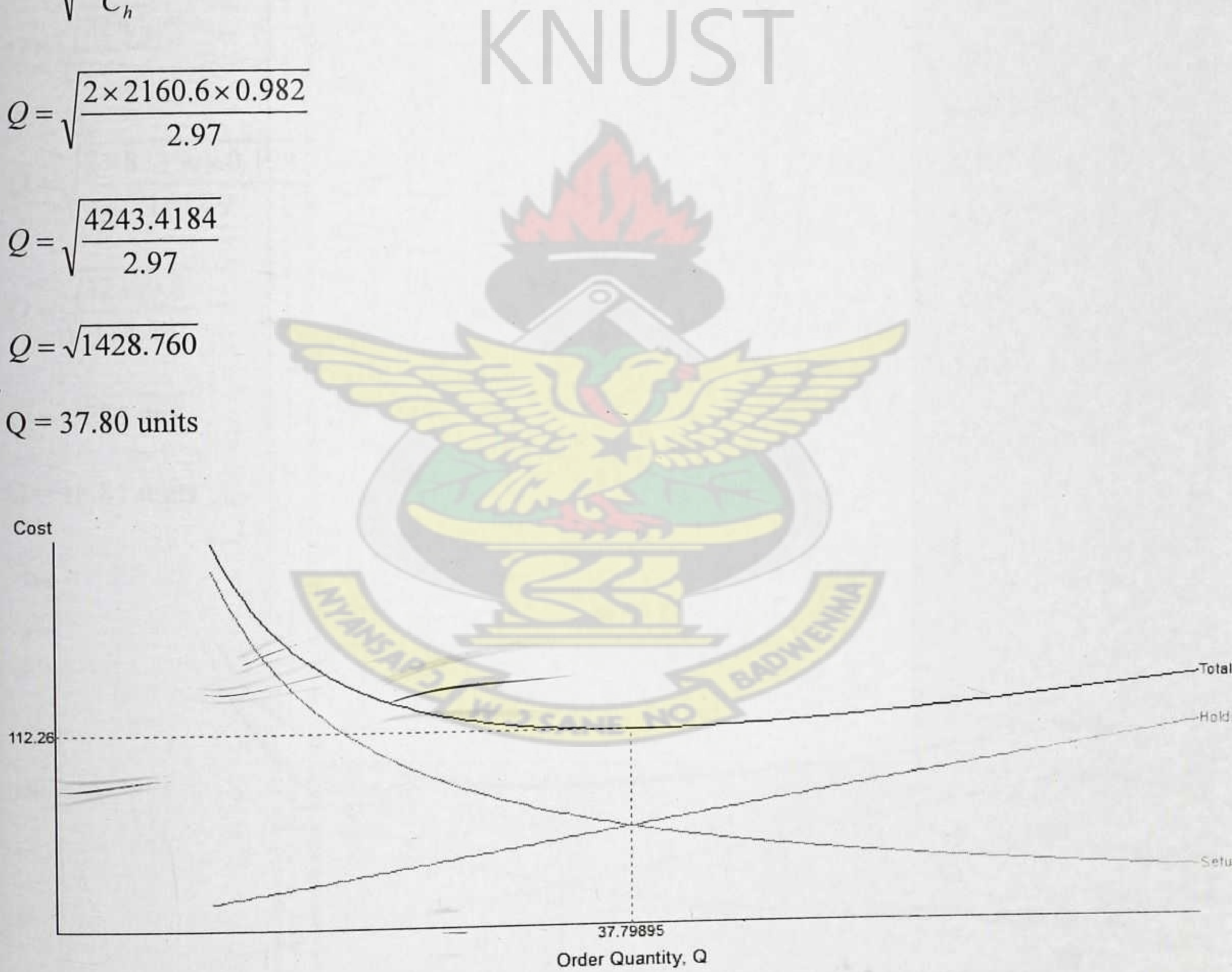


**Figure 4.7 Injuction Pellidins 100mg**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Injuction Pellidins 100mg for the year is 37.8 units whereas it will cost the hospital GH¢112.26

### 4.1.8 Injection X-Pen (Benzyl Penicillin Imu)

Annual Demand = 83350

Ordering Cost Per Unit = 0.194

Carrying Cost Per Unit = 83350/728= 114.49

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 83350 \times 0.194}{114.49}}$$

$$Q = \sqrt{\frac{32339.8}{114.49}}$$

$$Q = \sqrt{282.468}$$

Q = 16.81 units

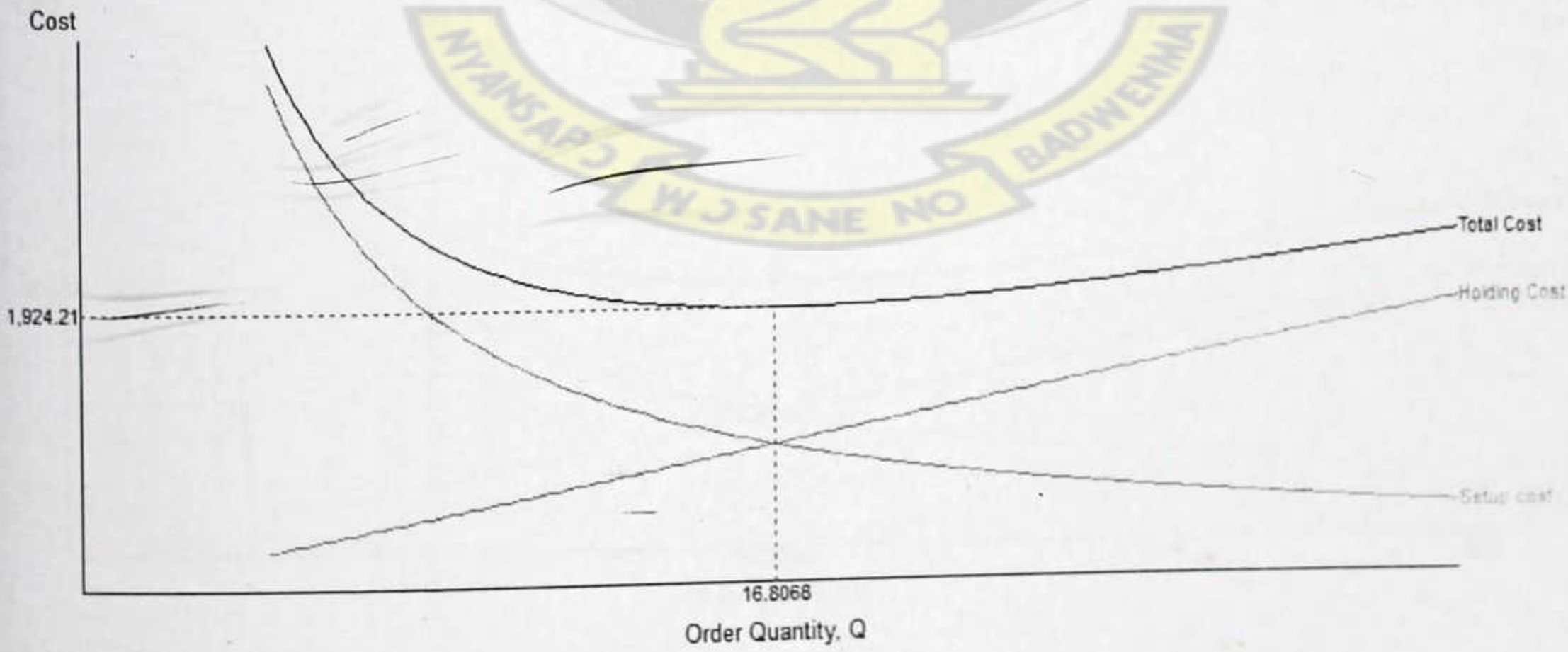


**Figure 4.8 Injection X-Pen (Benzyl Penicillin Imu)**
**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Injection X-Pen (Benzyl Penicillin Imu) for the year is 16.81 units whereas it will cost the hospital GH¢1,924.21.

### 4.1.9 Magnesium Tricilicate +Aluminium Hydroxide Mix

Annual Demand = 3010.2

Ordering Cost Per Unit = 0.9

Carrying Cost Per Unit = 3010.2/728= 4.13

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 3010.2 \times 0.9}{4.13}}$$

$$Q = \sqrt{\frac{5418.36}{4.13}}$$

$$Q = \sqrt{1311.95}$$

Q = 36.22 units

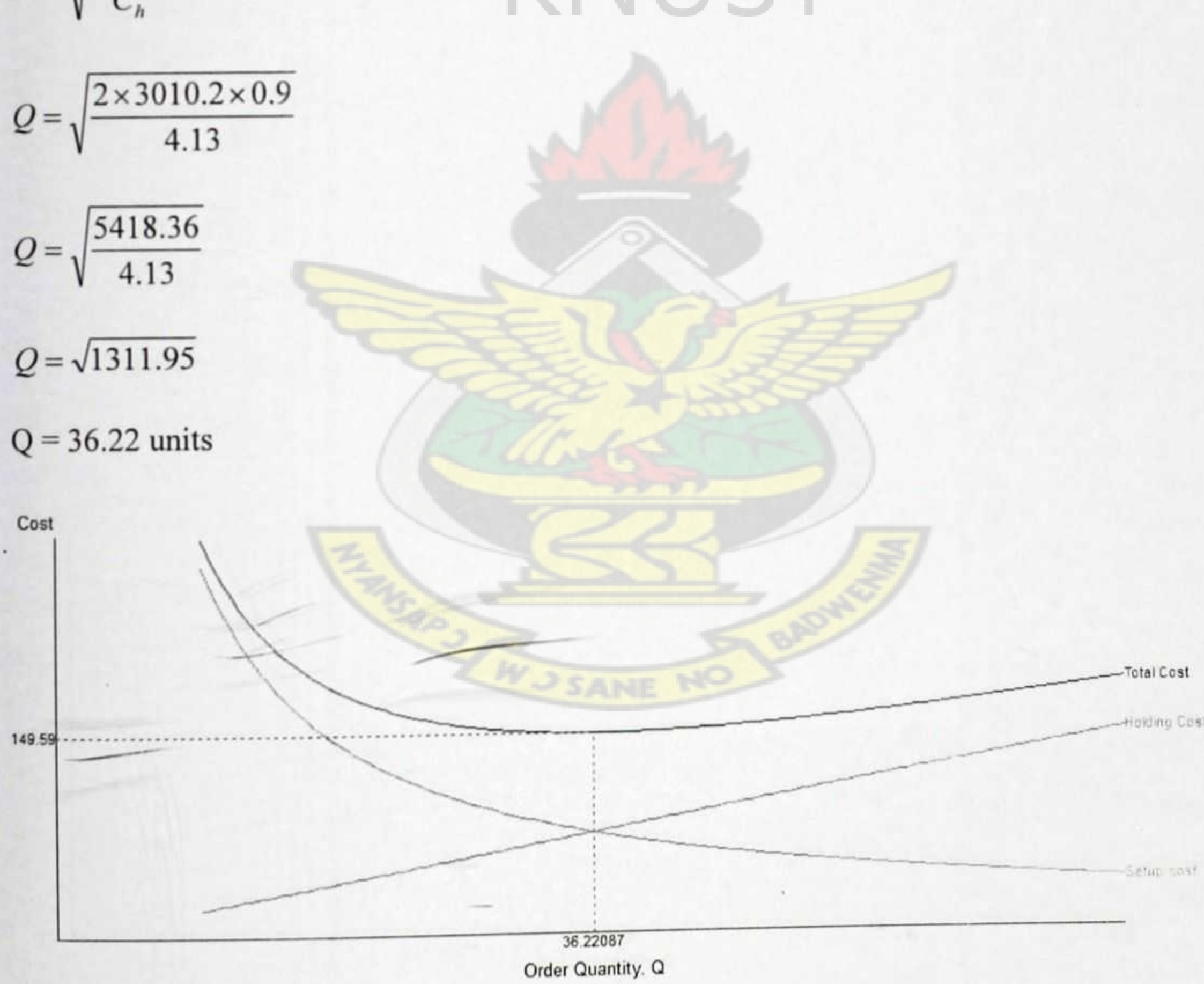


**Figure 4.9 Magnesium Tricilicate +Aluminium Hydroxide Mix**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Magnesium Tricilicate +Aluminium Hydroxide Mix for the year is 36.22 units whereas it will cost the hospital GH¢149.59.

### 4.1.10 Paracetamol Supp. 125mg

Annual Demand = 27262

Ordering Cost Per Unit = 0.513

Carrying Cost Per Unit = 27262/728= 37.45

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 27262 \times 0.513}{37.45}}$$

$$Q = \sqrt{\frac{27970.812}{37.45}}$$

$$Q = \sqrt{746.884}$$

Q = 27.33 units

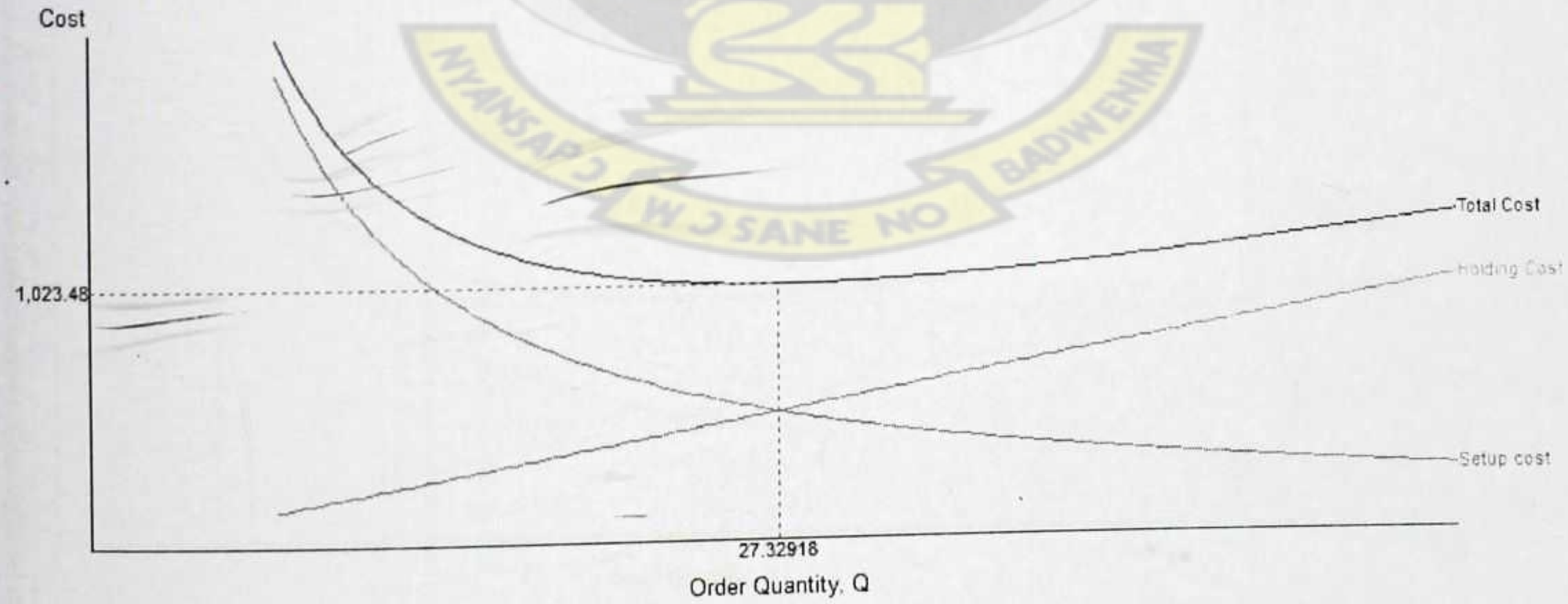


**Figure 4.10 Paracetamol sup 125mg**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Paracetamol sup 125mg for the year is 27.33 units whereas it will cost the hospital GH¢1023.48.

### 4.1.11 Salbutamol (syrup) 200ml

Annual Demand = 165.6

Ordering Cost Per Unit = 3.88

Carrying Cost Per Unit = 165.6/728= 0.23

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 165.6 \times 3.88}{0.23}}$$

$$Q = \sqrt{\frac{128.056}{0.23}}$$

$$Q = \sqrt{5587.2}$$

Q = 74.75 units

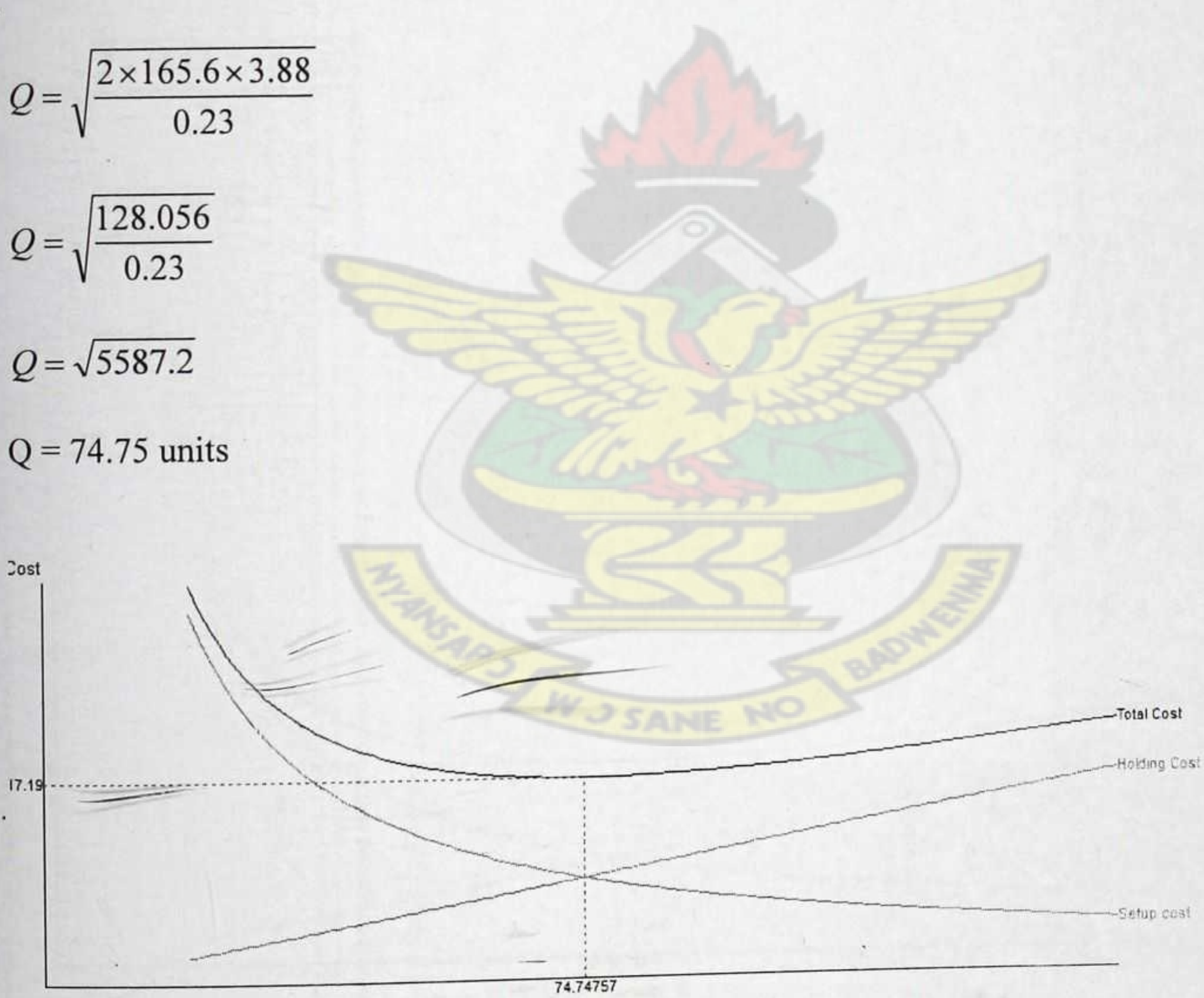


**Figure 4.11 Salbutamol (syrup) 200ml**
**Source: (Field Study, 2012)**

.From the above, it could be deduced that the EOQ Salbutamol (syrup) 200ml for the year is 74.75 units whereas it will cost the hospital GH¢17.19.

### 4.1.12 Susp. Albendazole 400mg

Annual Demand = 1534.8

Ordering Cost Per Unit = 0.632

Carrying Cost Per Unit = 1534.8/728= 2.11

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 1534.8 \times 0.632}{2.11}}$$

$$Q = \sqrt{\frac{1939.9872}{2.11}}$$

$$Q = \sqrt{919.43}$$

Q = 30.32 units

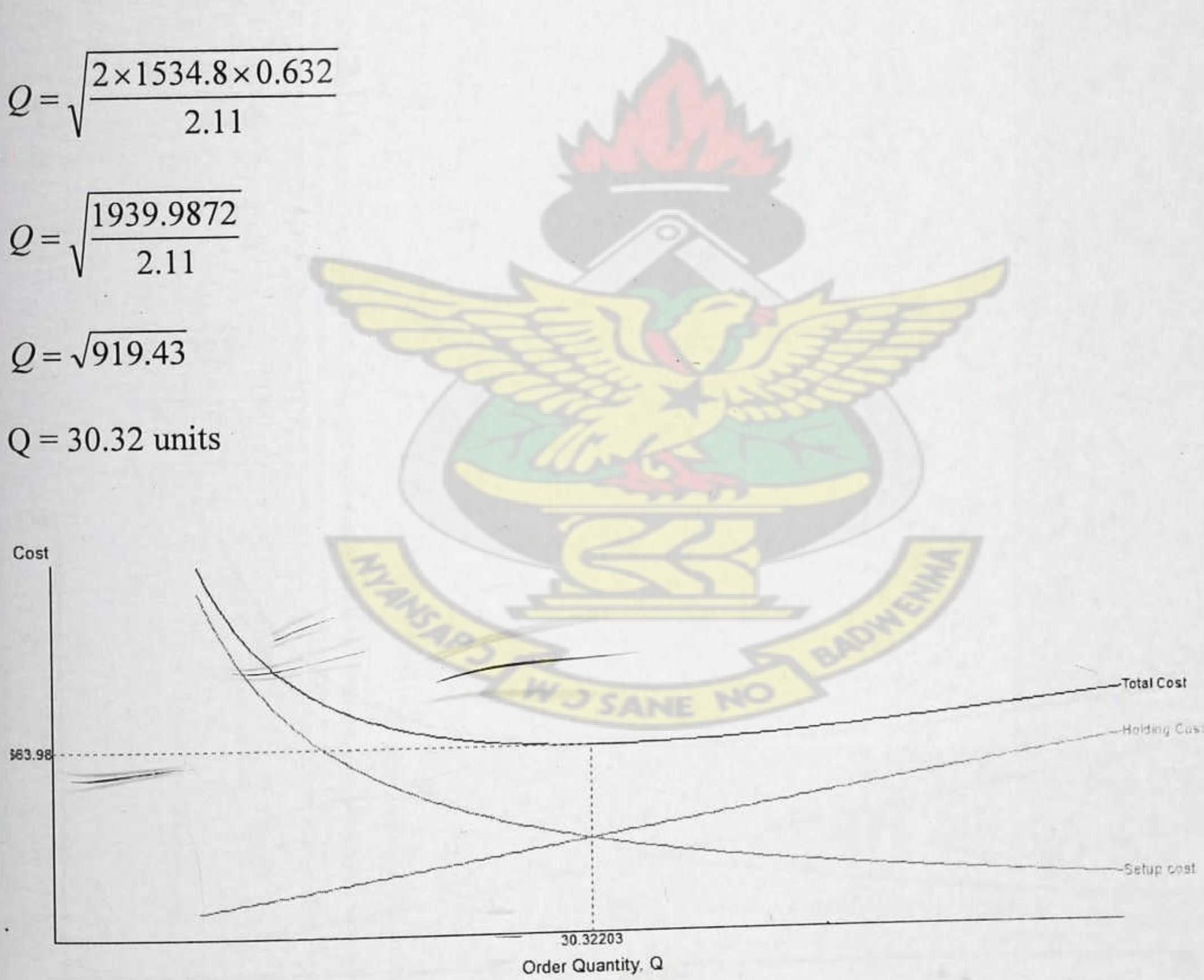


**Figure 4.12 Susp. Albendazole 400mg**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Susp. Albendazole 400mg for the year is 30.32 units whereas it will cost the hospital GH¢63.96.

### 4.1.13 Susp. Amoxyl (Amoxycillin)

Annual Demand = 4662.6

Ordering Cost Per Unit = 0.714

Carrying Cost Per Unit = 4662.6/728= 6.40

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 4662.6.8 \times 0.714}{6.40}}$$

$$Q = \sqrt{\frac{6658.1928}{6.40}}$$

$$Q = \sqrt{1040.3325}$$

Q = 32.25 units

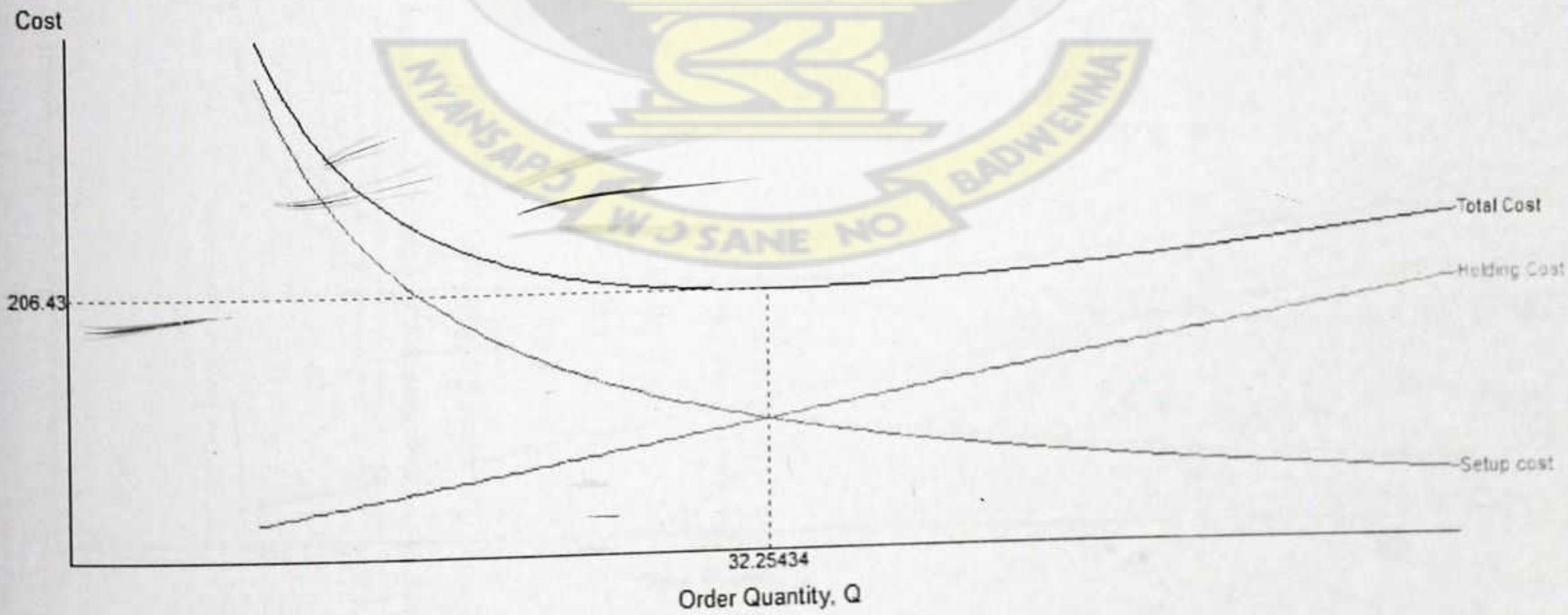


**Figure 4.13 Susp. Amoxyl (Amoxycillin)**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Susp. Amoxyl for the year is 32.25 units whereas it will cost the hospital GH¢206.43.

### 4.1.14 Syrup Erythromycin 125mg/5ml

Annual Demand = 1445

Ordering Cost Per Unit = 1.134

Carrying Cost Per Unit = 1445/728= 1.98

$$Q = \sqrt{\frac{2DC_o}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 1445 \times 1.13}{1.98}}$$

$$Q = \sqrt{\frac{3265.7}{1.98}}$$

$$Q = \sqrt{1649.34}$$

Q = 40.61 units


**Figure 14 Syrup Erythromycin 125mg/5ml**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Syrup Erythromycin 125mg/5ml for the year is 40.61 units whereas it will cost the hospital GH¢80.41.

### 4.1.15 Syrup Flagyl (Metronidazole)

Annual Demand = 2112.8

Ordering Cost Per Unit = 0.556

Carrying Cost Per Unit = 2112.8/728= 2.90

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 2112.8 \times 556}{2.90}}$$

$$Q = \sqrt{\frac{2349.4336}{2.90}}$$

$$Q = \sqrt{810.1495}$$

Q = 28.46 units

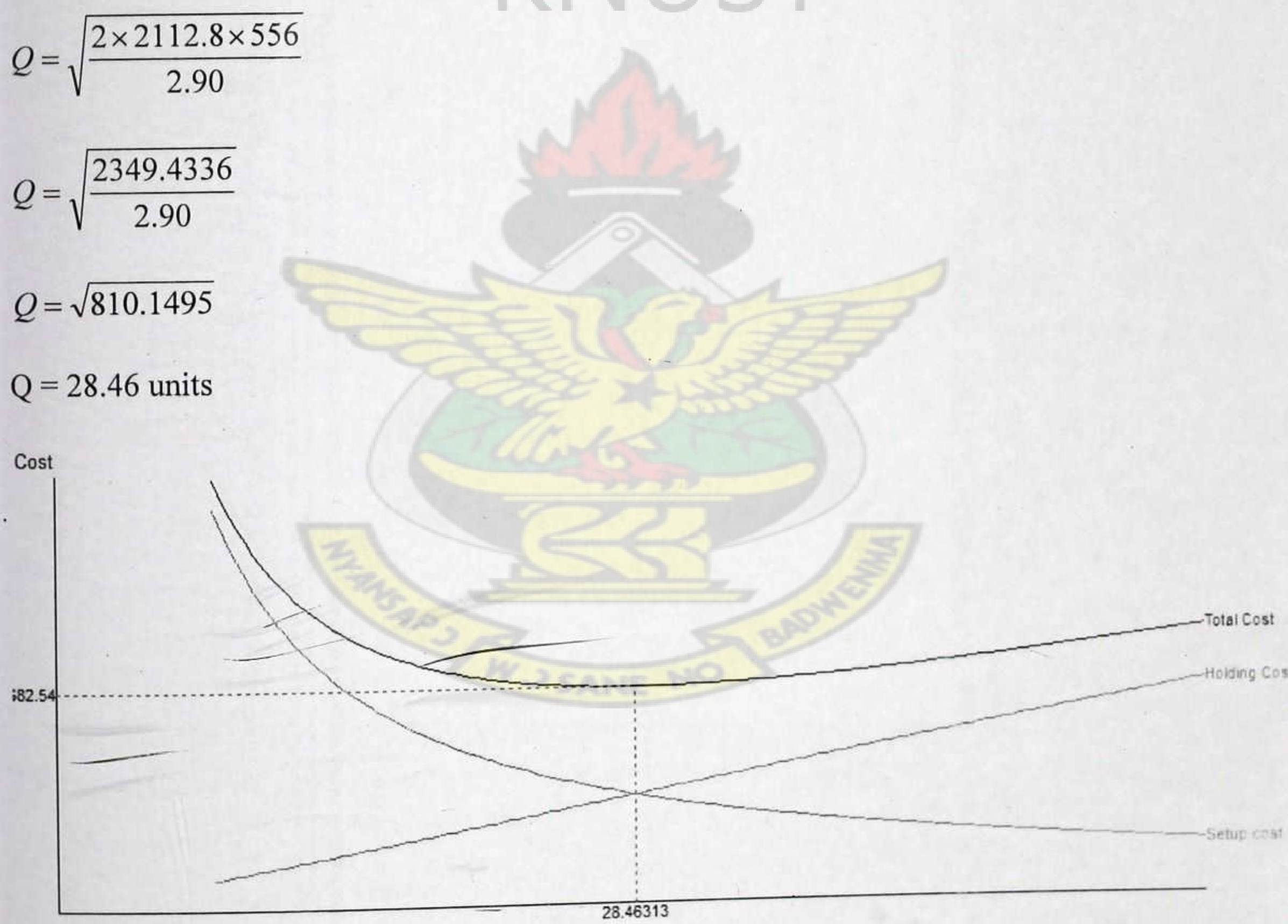


**Figure 4.15 Syrup Flagyl (Metronidazole)**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Syrup Flagyl (Metronidazole) for the year is 28.46 units whereas it will cost the hospital GH¢82.54

### 4.1.16 Syrup Flucloxacillin

Annual Demand = 2244.6

Ordering Cost Per Unit = 0.956

Carrying Cost Per Unit = 2244.6/728= 3.08

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 2244.6 \times 0.956}{3.08}}$$

$$Q = \sqrt{\frac{4291.6752}{3.08}}$$

$$Q = \sqrt{1393.40}$$

Q = 37.33 units

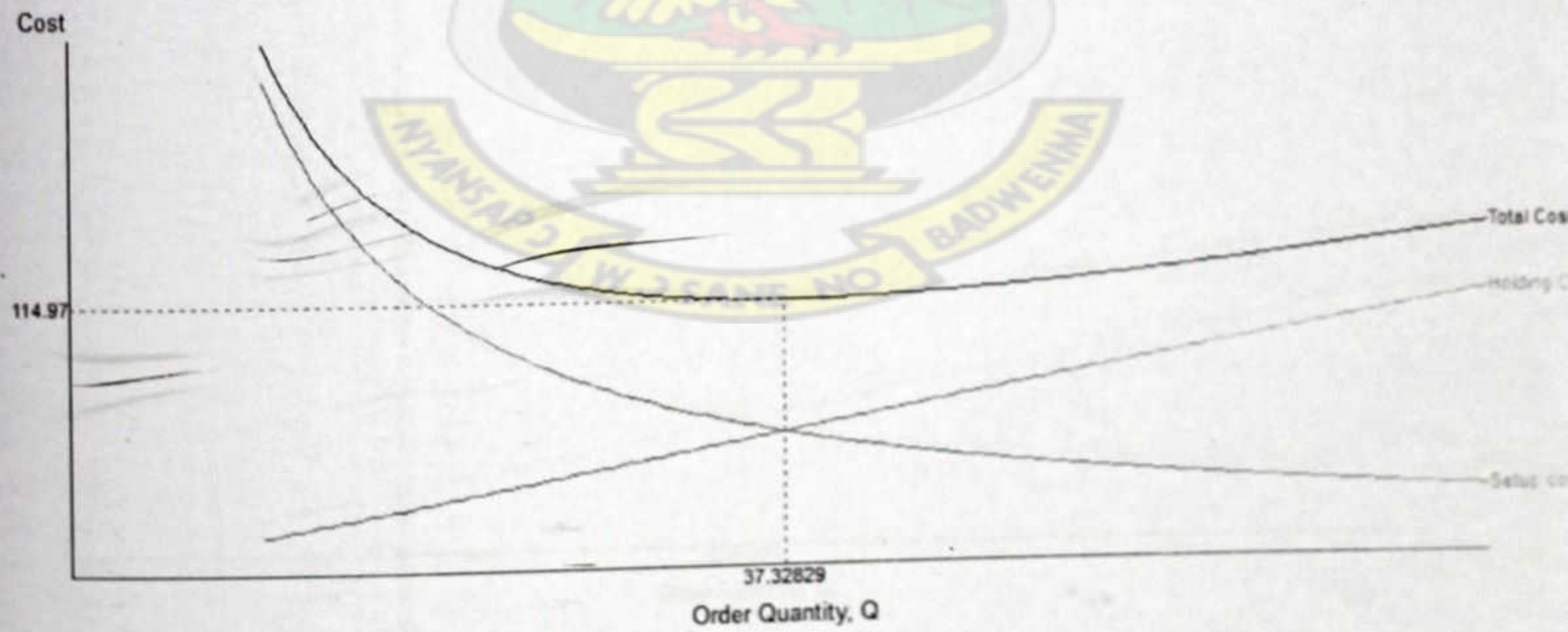


**Figure 4.16 Syrup Flucloxacillin**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Syrup Flucloxacillin for the year is 37.33 units whereas it will cost the hospital GH¢114.97.

### 4.1.17 Syrup Multivitamin

Annual Demand = 4868

Ordering Cost Per Unit = 0.49

Carrying Cost Per Unit = 4868/728=6.68

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 4868 \times 0.49}{6.68}}$$

$$Q = \sqrt{\frac{4770.64}{6.68}}$$

$$Q = \sqrt{714.17}$$

Q = 26.72 units

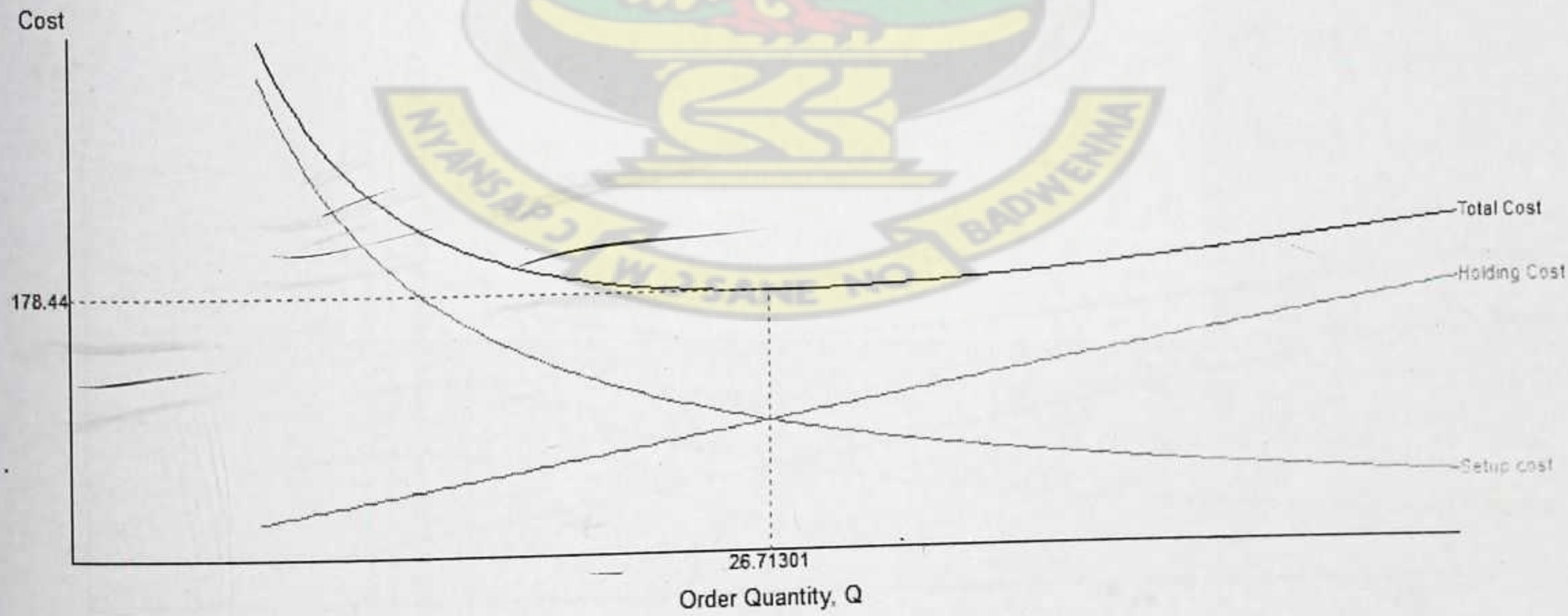


**Figure 4.17 Syrup Multivitamin**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Syrup Multivitamin for the year is 26.72 units whereas it will cost the hospital GH¢176.44

### 4.1.18 Tab Amlodipine 10mg

Annual Demand = 70080.4

Ordering Cost Per Unit = 0.108

Carrying Cost Per Unit = 70080.4/728=96.26

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 70080.4 \times 0.108}{96.26}}$$

$$Q = \sqrt{\frac{15137.3664}{96.26}}$$

$$Q = \sqrt{157.255}$$

Q = 12.54 units

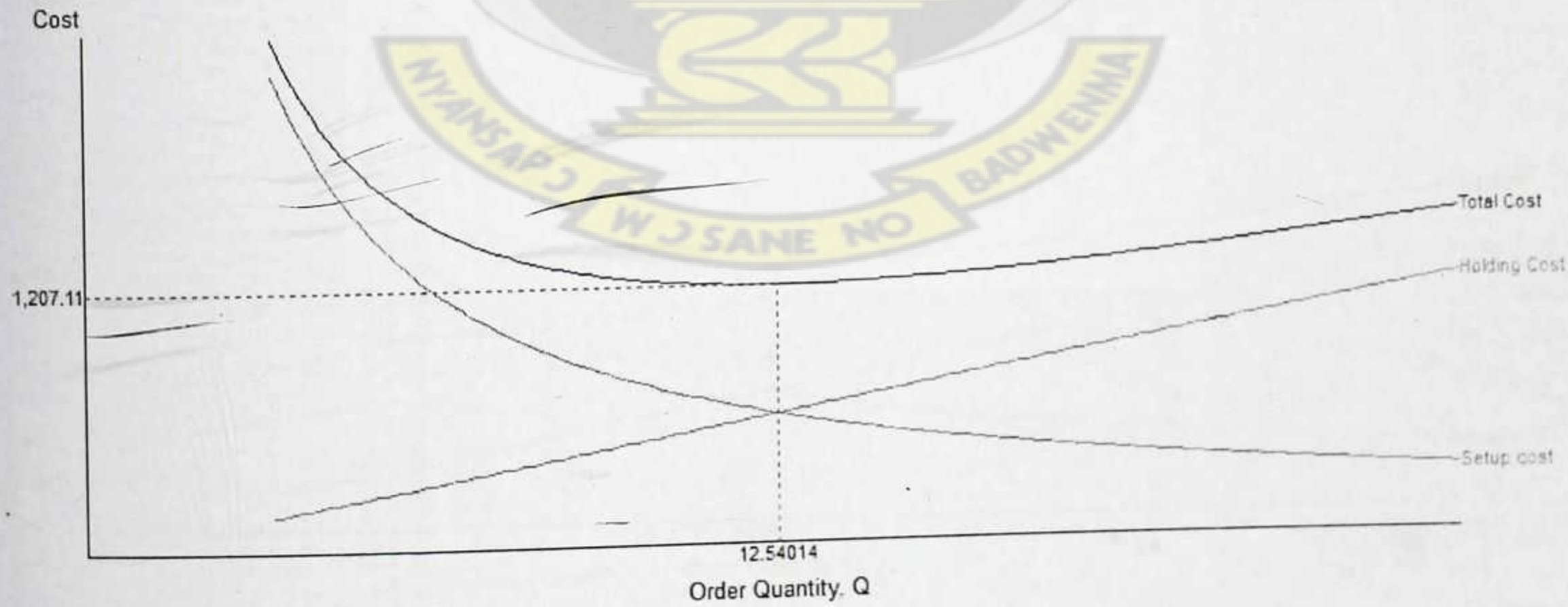


**Figure 4.18 Tab Amlodipine 10mg**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Tab Amlodipline 10mg for the year is 12.54 units whereas it will cost the hospital GH¢1207.11

### 4.1.19 Tab Buscopan 10mg (Hyoscine Butyl Bromide)

Annual Demand = 248700

Ordering Cost Per Unit = 0.045

Carrying Cost Per Unit = 248700/728=341.62

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 248700 \times 0.045}{341.62}}$$

$$Q = \sqrt{\frac{22383}{341.62}}$$

$$Q = \sqrt{65.5201}$$

Q = 8.09 units

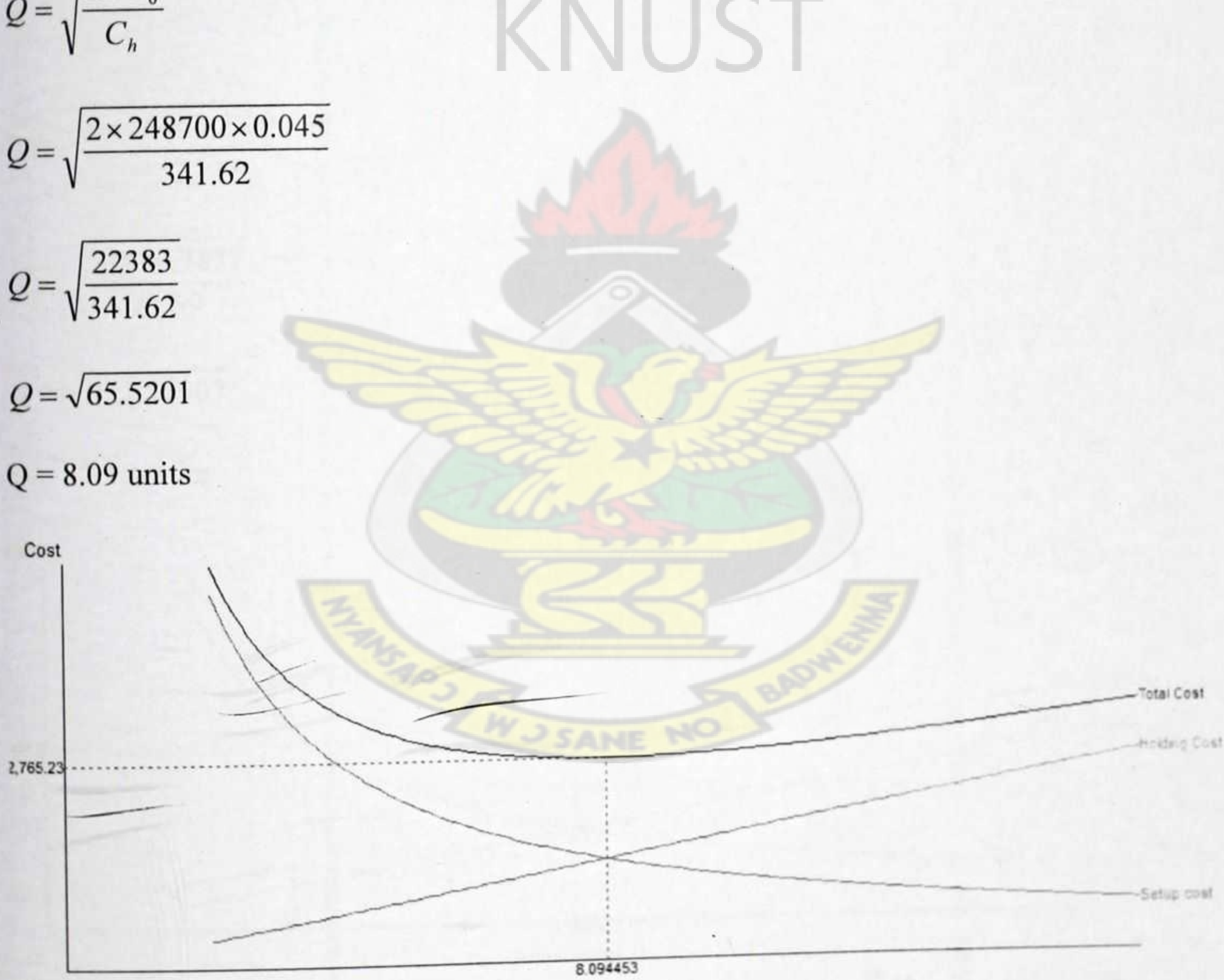


**Figure 4.19 Tab Buscopan 10mg (Hyoscine Butyl Bromide)**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Tab Buscopan 10mg (Hyosine Butyl Bromide) for the year is 8.09 units whereas it will cost the hospital GH¢2,765.23.

### 4.1.20 Tab Cefuroxime (Zinnat) 250mg

Annual Demand = 16445.2

Ordering Cost Per Unit = 0.668

Carrying Cost Per Unit = 16445.2/728=22.59

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 16445.2 \times 0.668}{22.59}}$$

$$Q = \sqrt{\frac{21970.7872}{22.59}}$$

$$Q = \sqrt{972.58907}$$

Q = 31.19 units

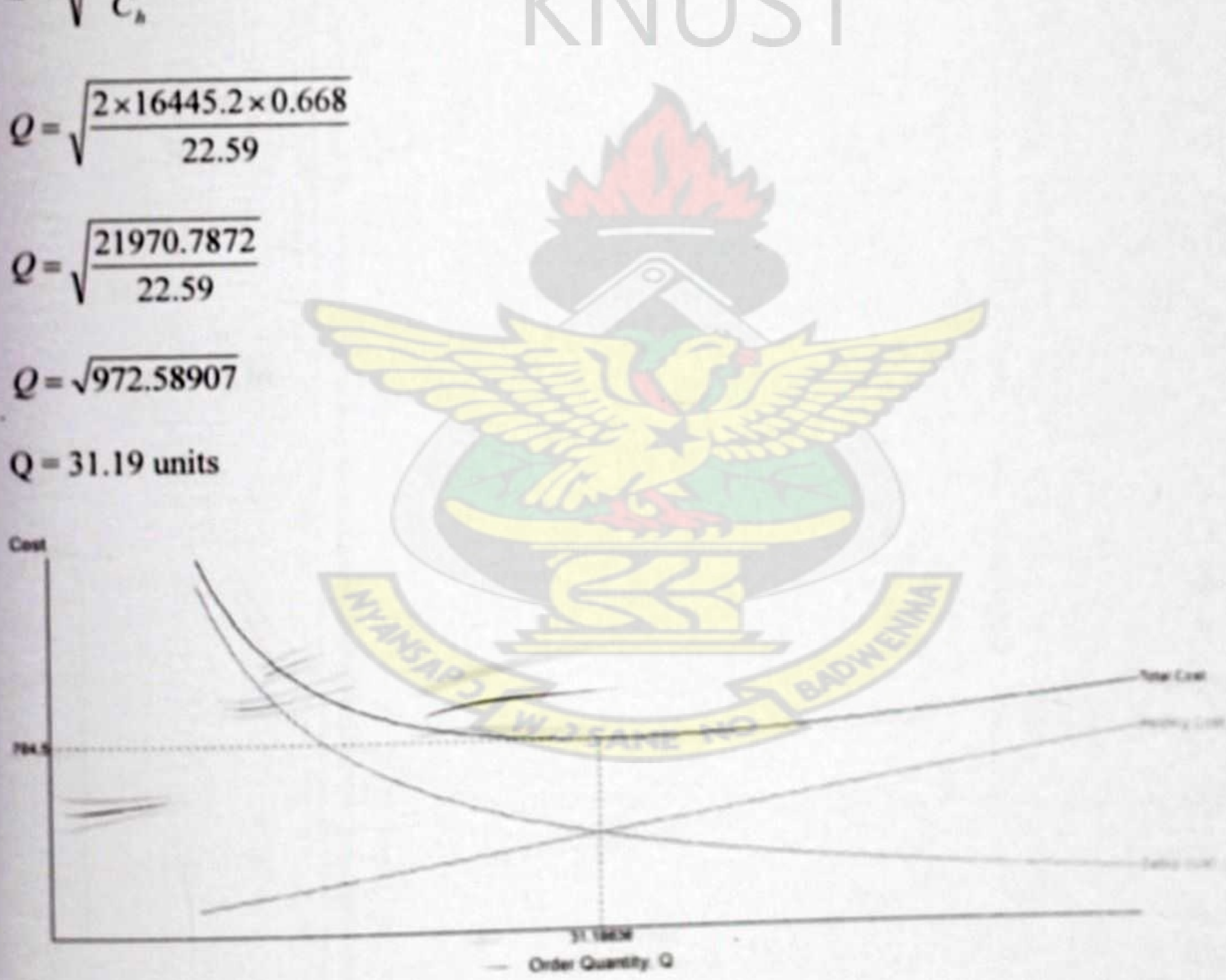


**Figure 4.20 Tab Cefuroxime (Zinnat) 250mg**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Tab Cefuroxime (Zinnat) 550mg for the year is 31.89 units whereas it will cost the hospital GH¢704.5.

### 4.1.21 Tab Multivite

Annual Demand = 365990

Ordering Cost Per Unit = 1.55

Carrying Cost Per Unit = 365990/728=502.04

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 365990 \times 1.55}{502.04}}$$

$$Q = \sqrt{\frac{1134569}{502.04}}$$

$$Q = \sqrt{2259.917536}$$

Q = 47.54 units

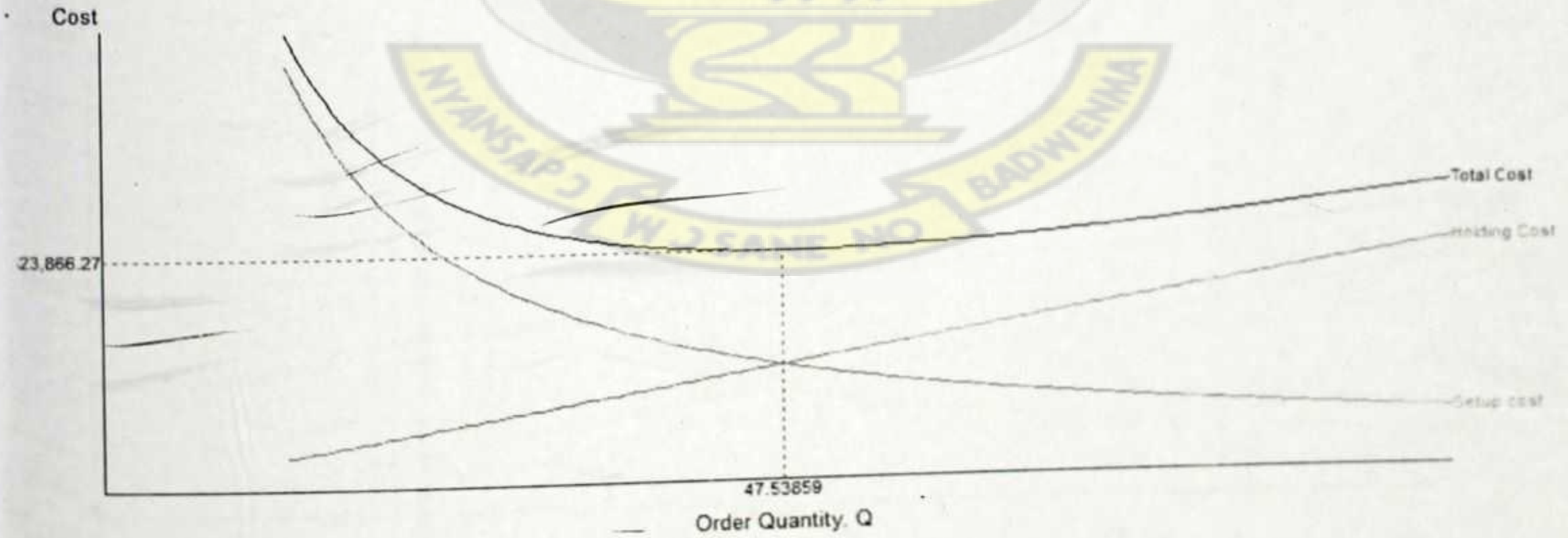


**Figure 4.21 Tab Multivite**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Tab Cefuroxime (Zinnat) 550mg for the year is 47.54 units whereas it will cost the hospital GH¢23,866.27.

### 4.1.22 Tab Nifidipine 20mg

Annual Demand = 153100

Ordering Cost Per Unit = 0.047

Carrying Cost Per Unit = 153100/728=210.3

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 153100 \times 0.047}{210.3}}$$

$$Q = \sqrt{\frac{14391.4}{210.3}}$$

$$Q = \sqrt{68.43}$$

Q = 8.27 units

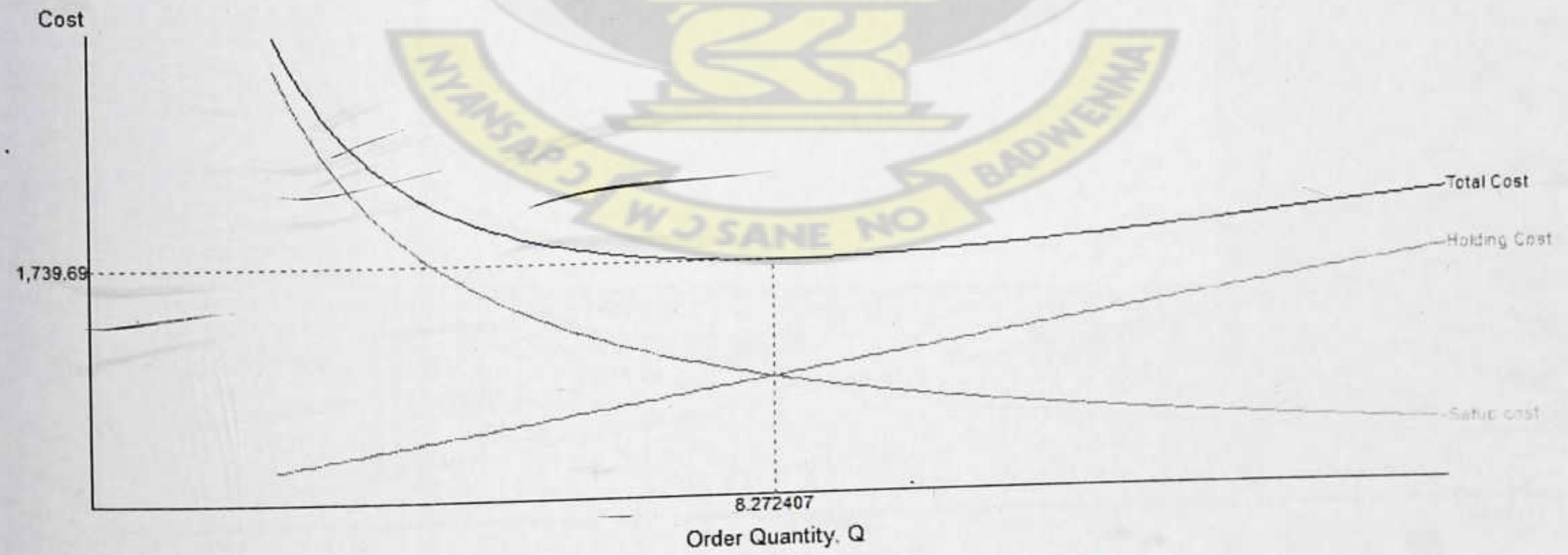


**Figure 4.22 Tab Nifidipine 20mg**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Tab Nifodipone 20gm for the year is 8.27 units whereas it will cost the hospital GH¢1,739.69

### 4.1.23 Tab Paracetamol 500mg

Annual Demand = 563700

Ordering Cost Per Unit = 0.006

Carrying Cost Per Unit = 563700/728=774.31

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 563700 \times 0.006}{774.31}}$$

$$Q = \sqrt{\frac{6764.4}{774.31}}$$

$$Q = \sqrt{8.736035}$$

Q = 2.96 units

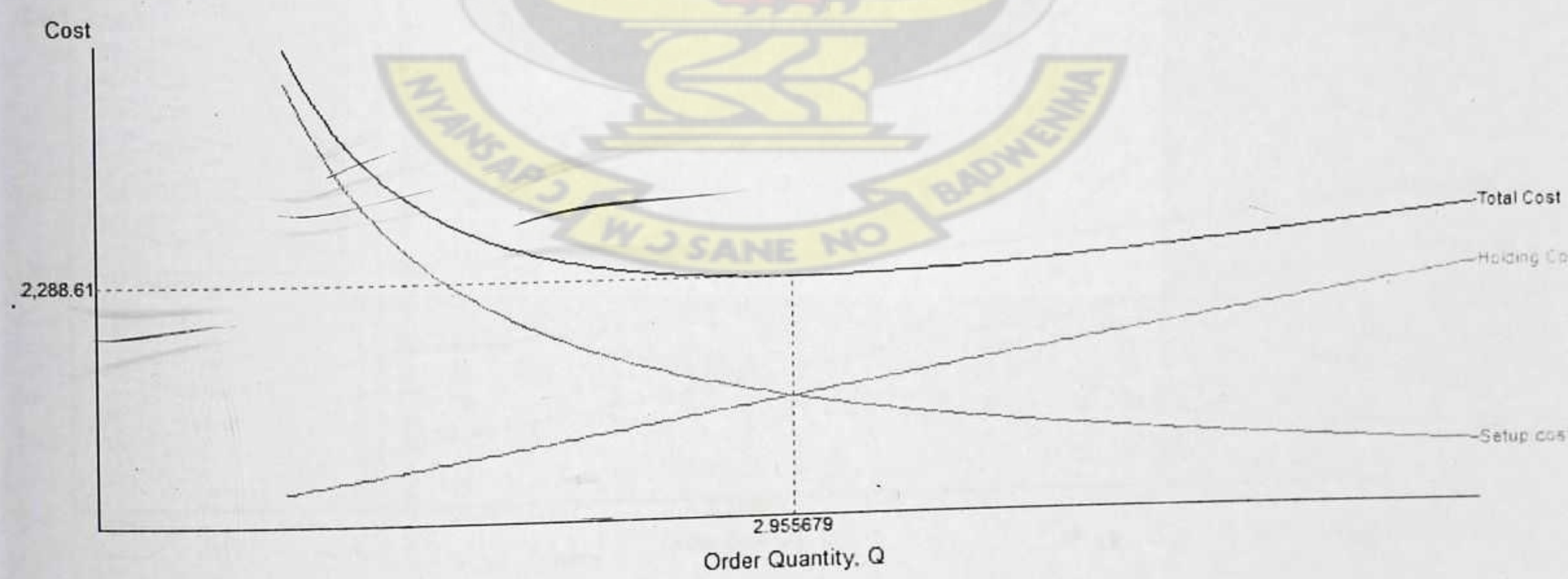


**Figure 4.23 Tab Paracetamol 500mg**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Tab Paracetamol 500mg for the year is 2.96 units whereas it will cost the hospital GH¢2288.61.

### 4.1.24 Tab Prednisoline 5mg

Annual Demand = 18870

Ordering Cost Per Unit = 0.019

Carrying Cost Per Unit = 18870/728=25.92

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 18870 \times 0.019}{25.92}}$$

$$Q = \sqrt{\frac{717.06}{25.92}}$$

$$Q = \sqrt{27.66435185}$$

Q = 5.26 units

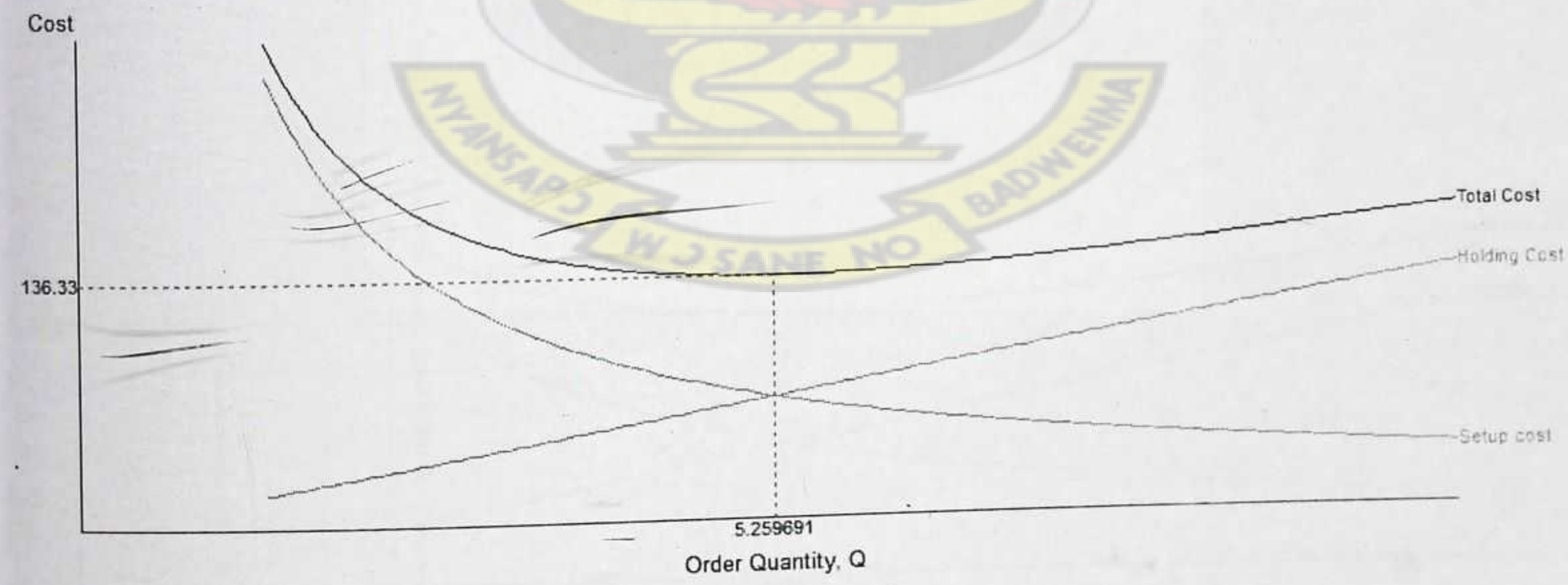


**Figure 4.24 Tab Prednisoline 5mg**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Tab Prednisoline 5mg for the year is 5.26 units whereas it will cost the hospital GH¢136.33

### 4.1.25 Timolol (Eye Drop) 0.5%

Annual Demand = 899.2

Ordering Cost Per Unit = 2.93

Carrying Cost Per Unit = 899.2/728=1.23

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 899.2 \times 2.93}{1.23}}$$

$$Q = \sqrt{\frac{5269.312}{1.23}}$$

$$Q = \sqrt{4283.993495934}$$

Q = 65.45 units

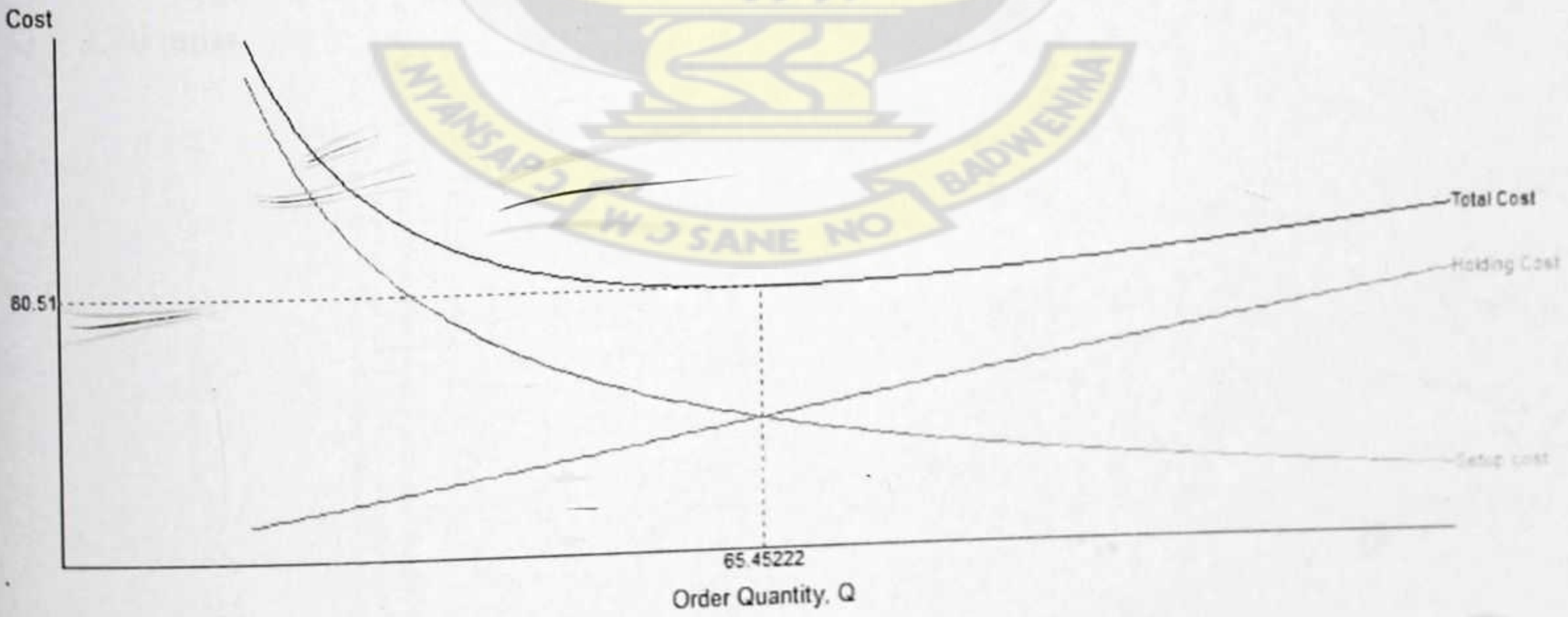


**Figure 4.25 Timolol (Eye Drop) 0.5%**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Timolol (Eye Drop) 0.5% for the year is 65.45 units whereas it will cost the hospital GH¢80.51

### 4.1.26 Ascorbic Acid

Annual Demand = 124440

Ordering Cost Per Unit = 0.005

Carrying Cost Per Unit = 124440/728=170.93

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 124440 \times 0.005}{170.93}}$$

$$Q = \sqrt{\frac{1244.4}{170.93}}$$

$$Q = \sqrt{7.28017317}$$

Q = 2.70 units

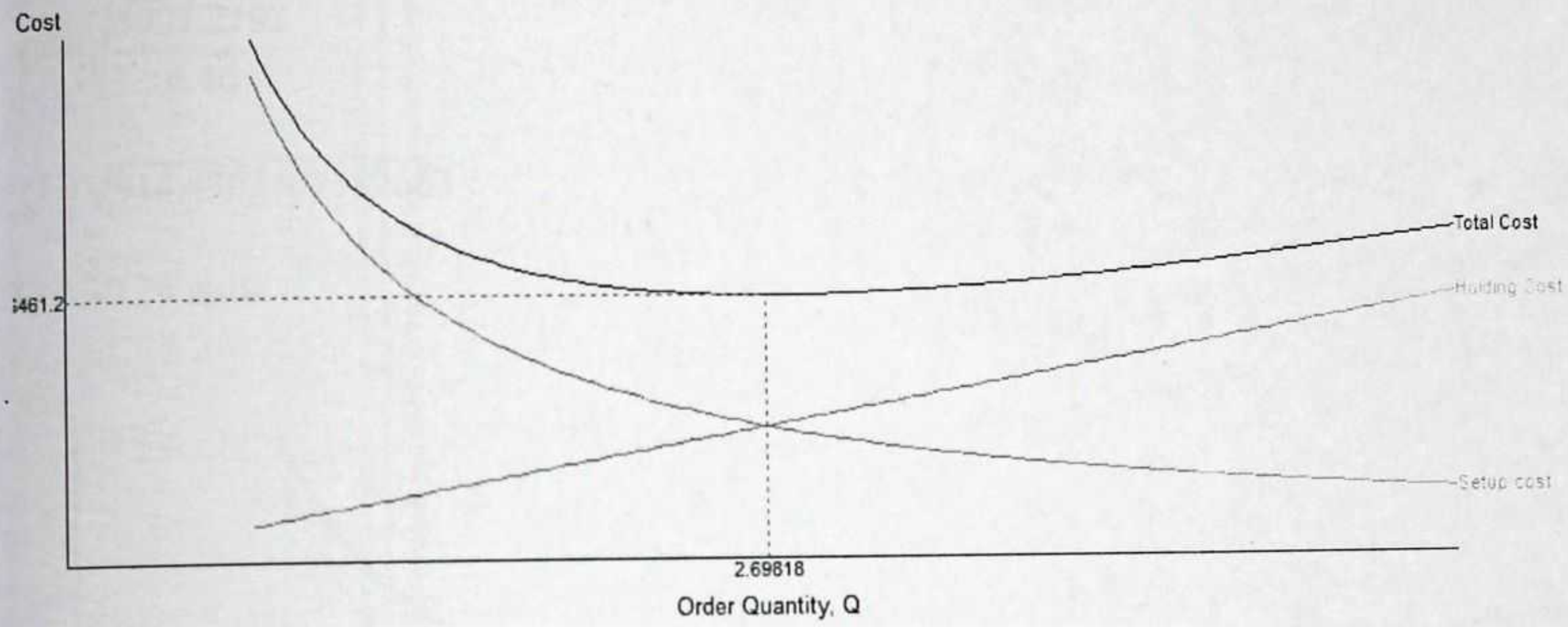




**Figure 4.26 Ascorbic Acid**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Ascorbic Acid for the year is 2.70 units whereas it will cost the hospital GH¢461.2

### 4.1.27 Azithromycin 250mg

Annual Demand = 4703.2

Ordering Cost Per Unit = 0.628

Carrying Cost Per Unit = 124440/728=6.46

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 4703.2 \times 0.628}{6.46}}$$

$$Q = \sqrt{\frac{5907.2192}{6.46}}$$

$$Q = \sqrt{914.4302167182663}$$

Q = 30.24 units

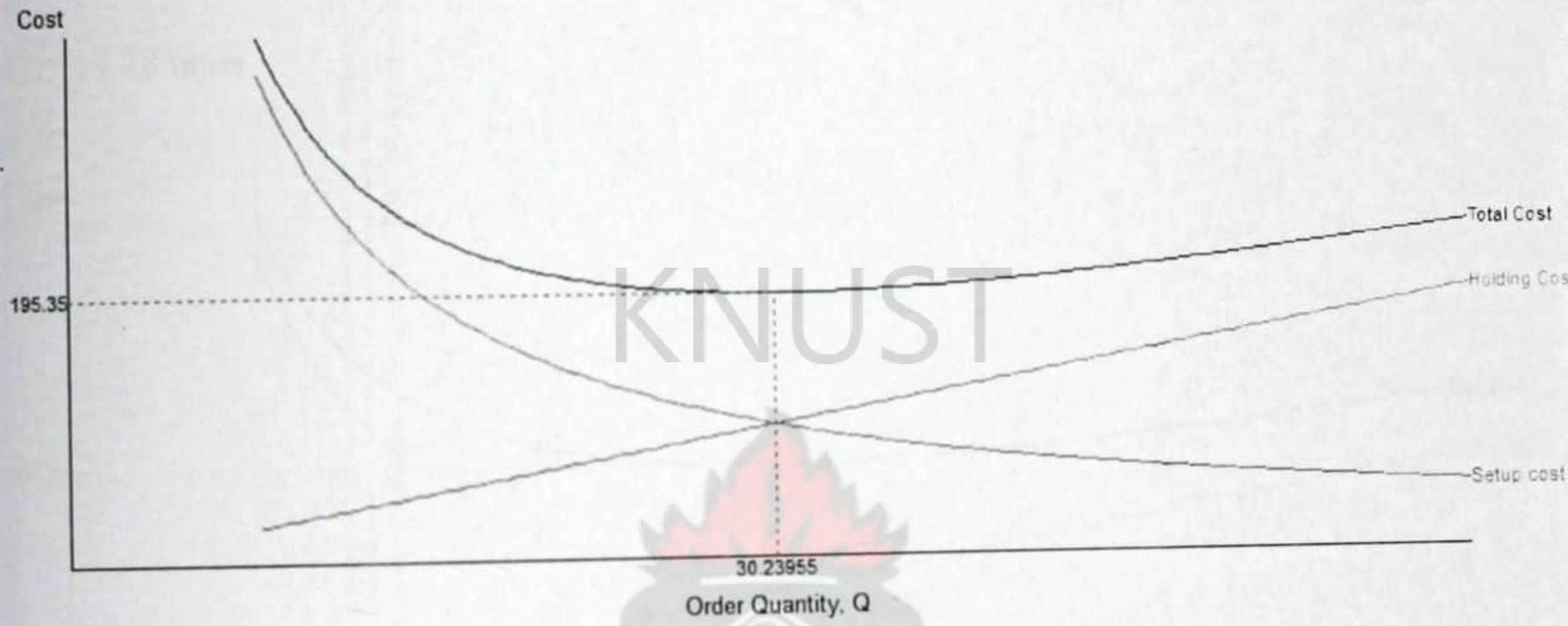


**Figure 4.27 Azithromycin 250mg**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Azithromycin 250mg for the year is 30.24 units whereas it will cost the hospital GH¢195.35

### 4.1.28 Cap Tramadol 50mg

Annual Demand = 12300

Ordering Cost Per Unit = 0.14

Carrying Cost Per Unit = 12300/728=16.9

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 12300 \times 0.14}{16.9}}$$

$$Q = \sqrt{\frac{3444}{16.9}}$$

$$Q = \sqrt{203.79}$$

Q = 14.28 units

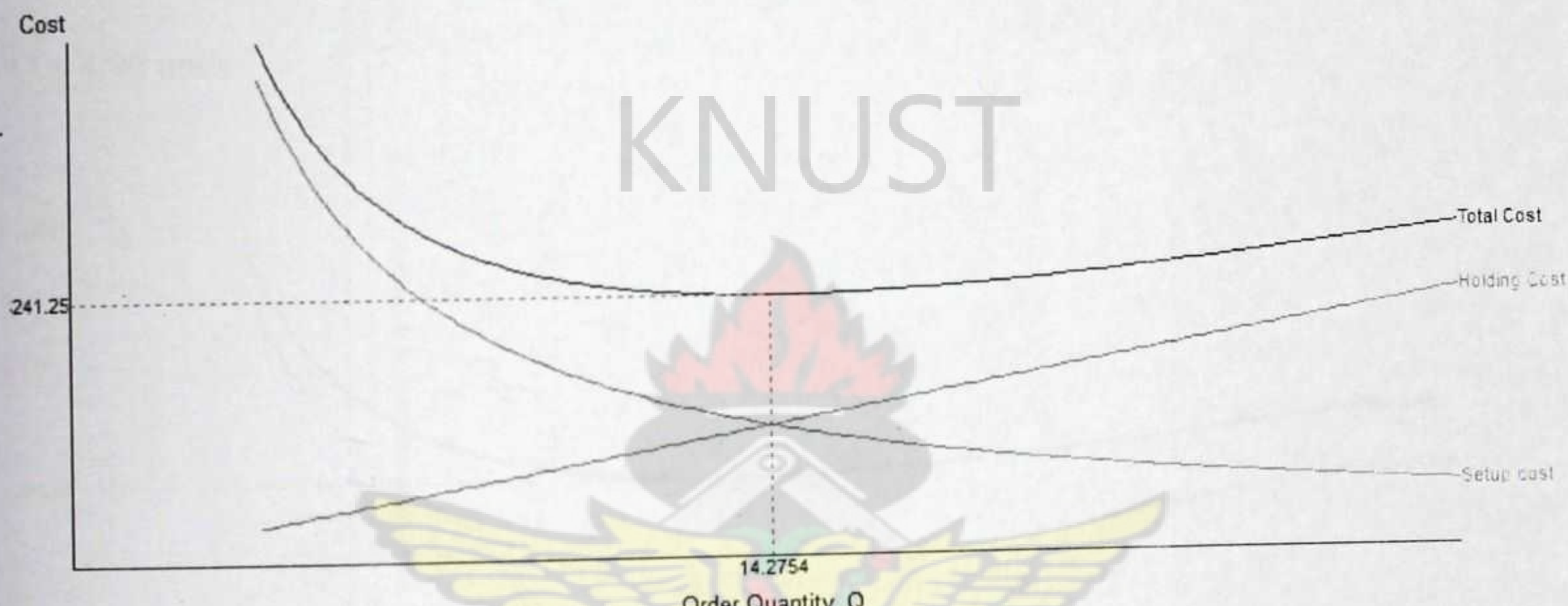


**Figure 4.28 Cap Tramadol 50mg**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Cap Tramadol 50mg for the year is 14.28 ~~units~~ whereas it will cost the hospital GH¢241.25.

### 4.1.29 Cotrimoxazole 480mg

Annual Demand = 70800

Ordering Cost Per Unit = 0.017

Carrying Cost Per Unit = 70800/728=97.25

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 70800 \times 0.017}{97.25}}$$

$$Q = \sqrt{\frac{2407.2}{97.25}}$$

$$Q = \sqrt{24.752699228}$$

Q = 4.96 units



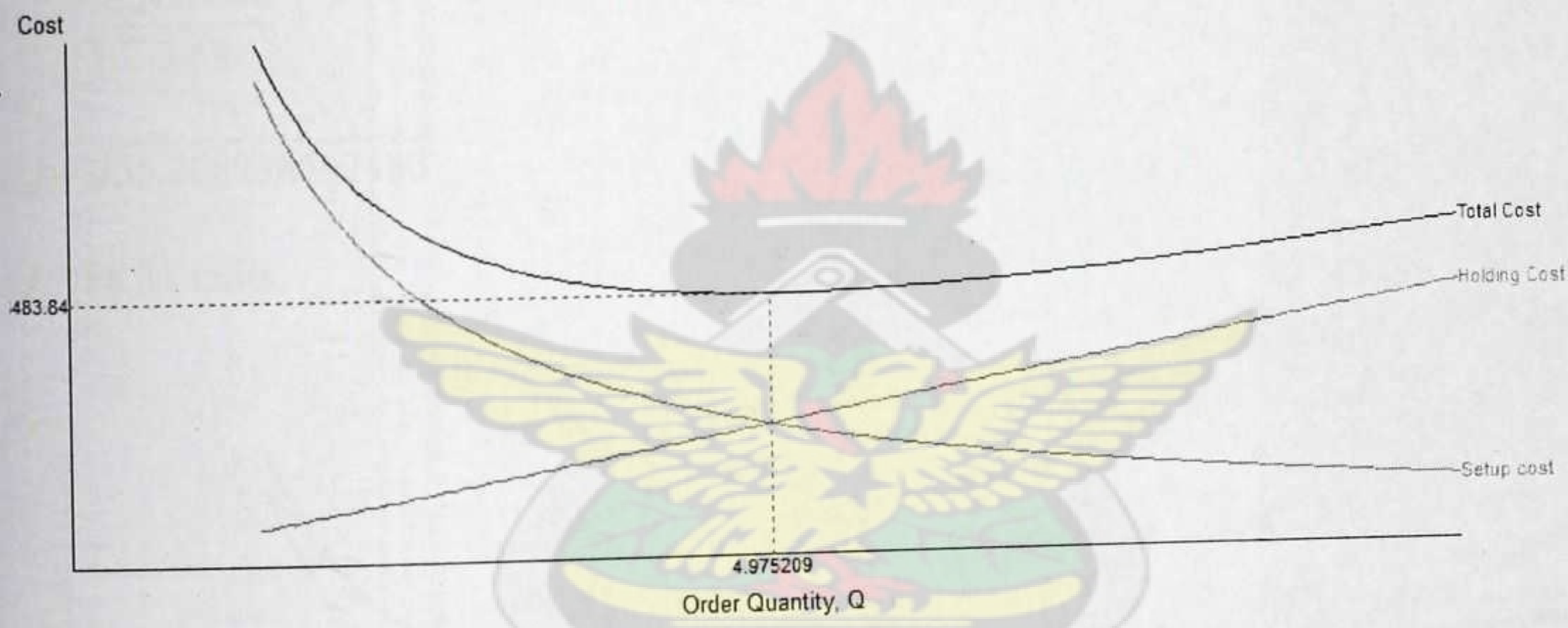


**Figure 4.29 Cotrimoxazole 480mg**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Cotrimaxazole 480mg for the year is 4.96 units whereas it will cost the hospital GH¢483.84.

### 4.1.30 Decatylene Lozenges

Annual Demand = 2608.8

Ordering Cost Per Unit = 0.23

Carrying Cost Per Unit = 70800/728=3.58

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 2608.8 \times 0.23}{3.58}}$$

$$Q = \sqrt{\frac{1200.048}{3.58}}$$

$$Q = \sqrt{35.2089385474 86}$$

Q = 18.31 units

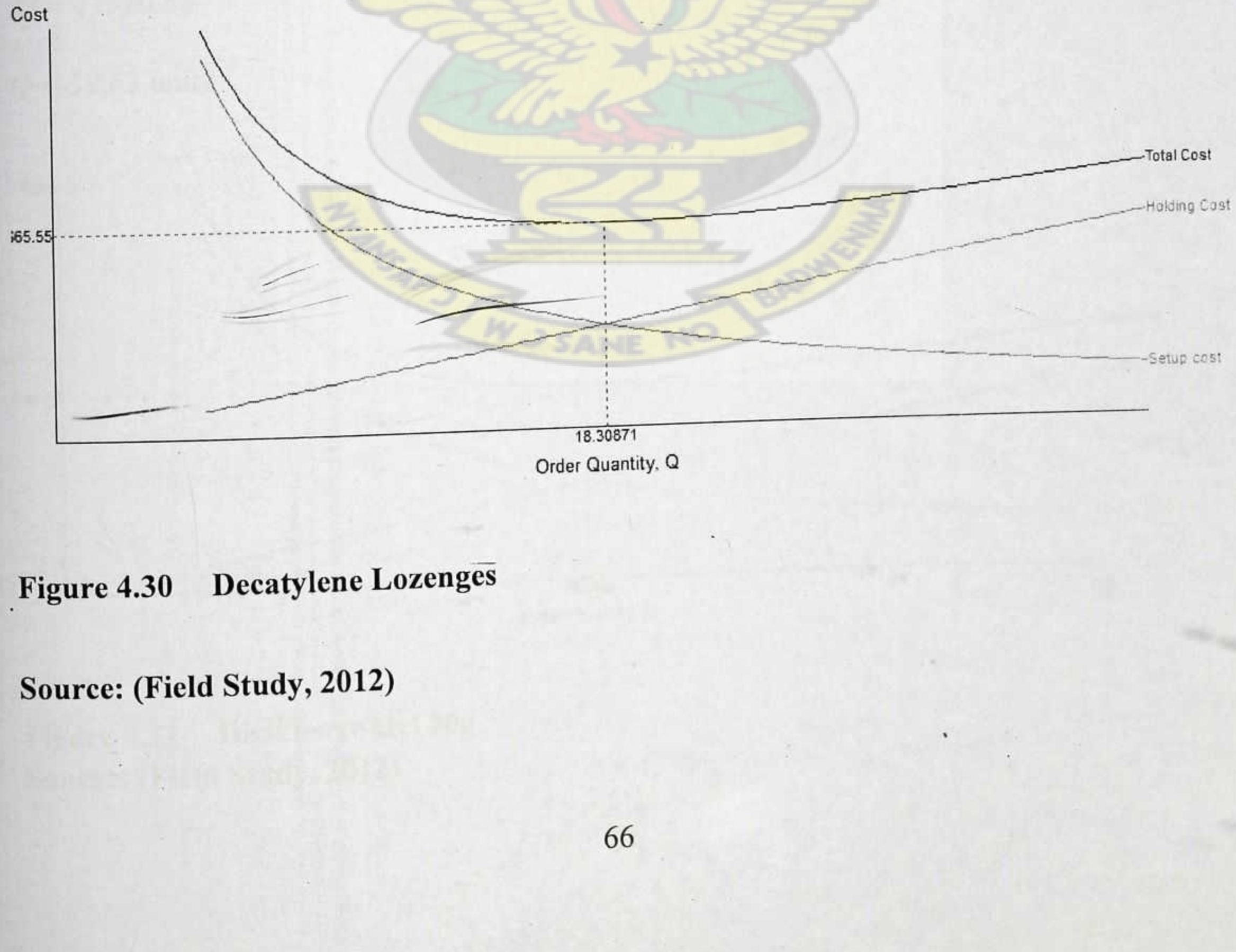


**Figure 4.30 Decatylene Lozenges**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Decatylene Lozenges for the year is 18.31 units whereas it will cost the hospital GH¢65.55.

### 4.1.31 Diclofenac Gel 30g

Annual Demand = 2574

Ordering Cost Per Unit = 1.08

Carrying Cost Per Unit = 2574/728=3.54

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 25748 \times 1.08}{3.54}}$$

$$Q = \sqrt{\frac{5559.84}{3.54}}$$

$$Q = \sqrt{1570.58}$$

Q = 39.63 units

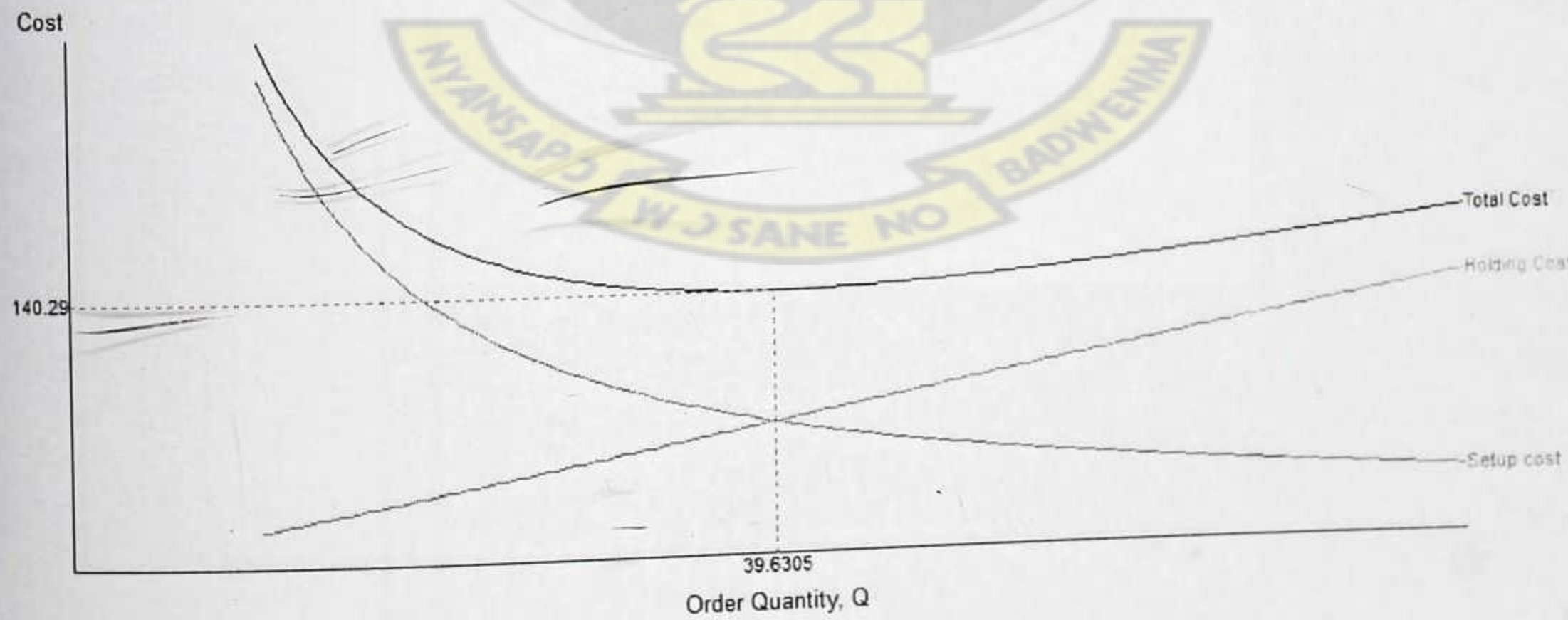


**Figure 4.31 Diclofenac Gel 30g**
**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Decatylene Lozenges for the year is 39.63 units whereas it will cost the hospital GH¢140.29

### 4.1.32 Flucloxacillin Capsules 250mg

Annual Demand = 125700

Ordering Cost Per Unit = 0.05

Carrying Cost Per Unit = 125700/728=172.66

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 125700 \times 0.05}{172.66}}$$

$$Q = \sqrt{\frac{12570}{172.66}}$$

$$Q = \sqrt{72.8020386}$$

Q = 8.53 units

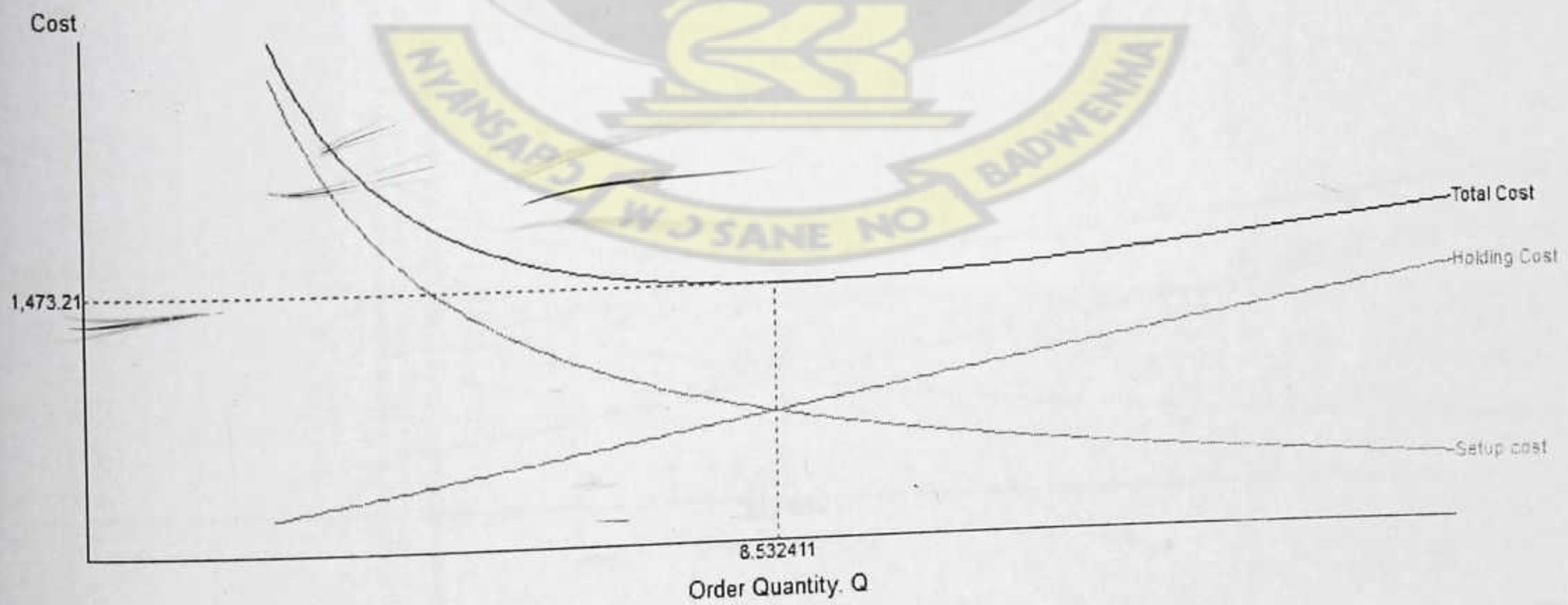


**Figure 4.32 Flucloxacillin Capsules 250mg**
**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Flucloxacillin Capsules 250mg for the year is 8.53 units whereas it will cost the hospital GH¢1,473.21

### 4.1.33 Frusemide 40mg

Annual Demand = 25300

Ordering Cost Per Unit = 0.59

Carrying Cost Per Unit = 25300/728=34.75

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 25300 \times 0.59}{34.75}}$$

$$Q = \sqrt{\frac{29854}{34.75}}$$

$$Q = \sqrt{859.107913}$$

Q = 29.31 units

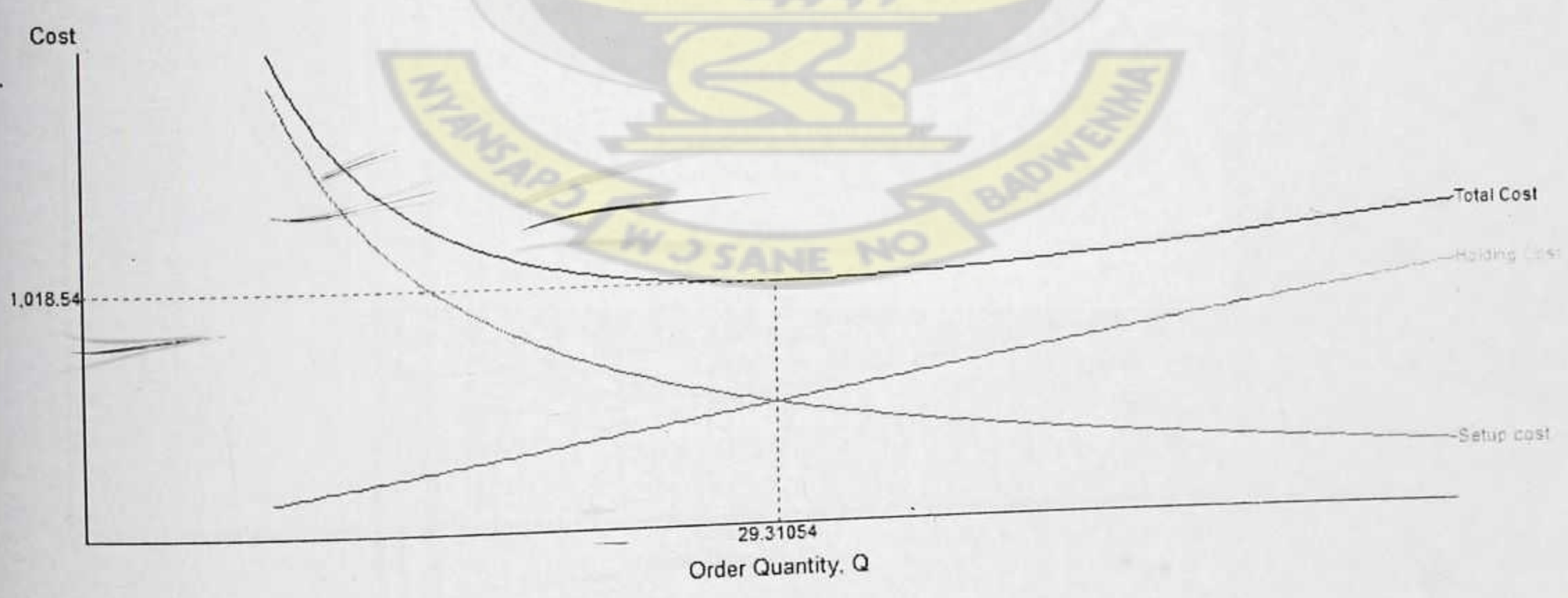


**Figure 4.33 Frusemide 40mg**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Frusemide 40mg for the year is 29.31 units whereas it will cost the hospital GH¢1,018.54

### 4.1.34 Inj. Diclofenac 75mg

Annual Demand = 6829.2

Ordering Cost Per Unit = 0.2

Carrying Cost Per Unit = 6829.2/728=9.38

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 6829.2 \times 0.2}{9.38}}$$

$$Q = \sqrt{\frac{2731.68}{9.38}}$$

$$Q = \sqrt{291.2238805}$$

Q = 17.07 units

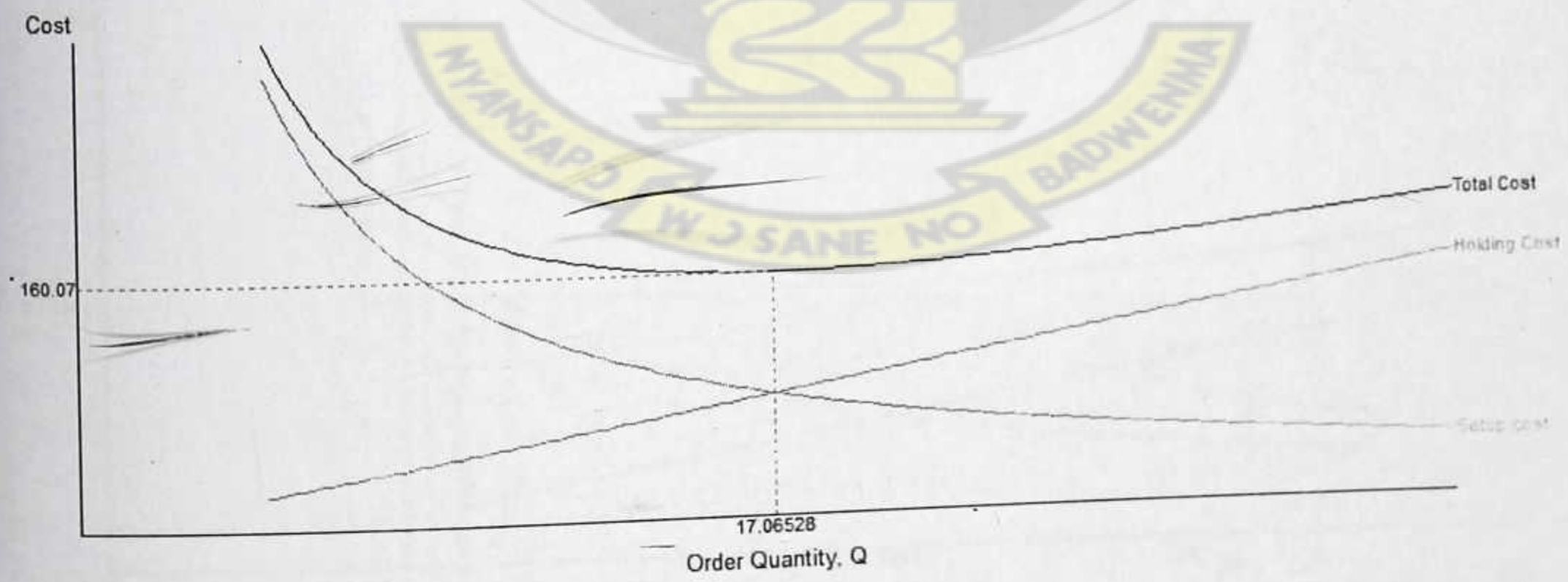


**Figure 4.34 Inj. Diclofenac 75mg**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Inj. Diclofenac 75mg for the year is 17.07 units whereas it will cost the hospital GH¢160.07

### 4.1.35 Iron III (Cap Haematonics)

Annual Demand = 230478

Ordering Cost Per Unit = 0.59

Carrying Cost Per Unit = 230478/728=316.59

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 230478 \times 0.59}{316.59}}$$

$$Q = \sqrt{\frac{271964.04}{316.59}}$$

$$Q = \sqrt{859.01478}$$

Q = 29.31 units

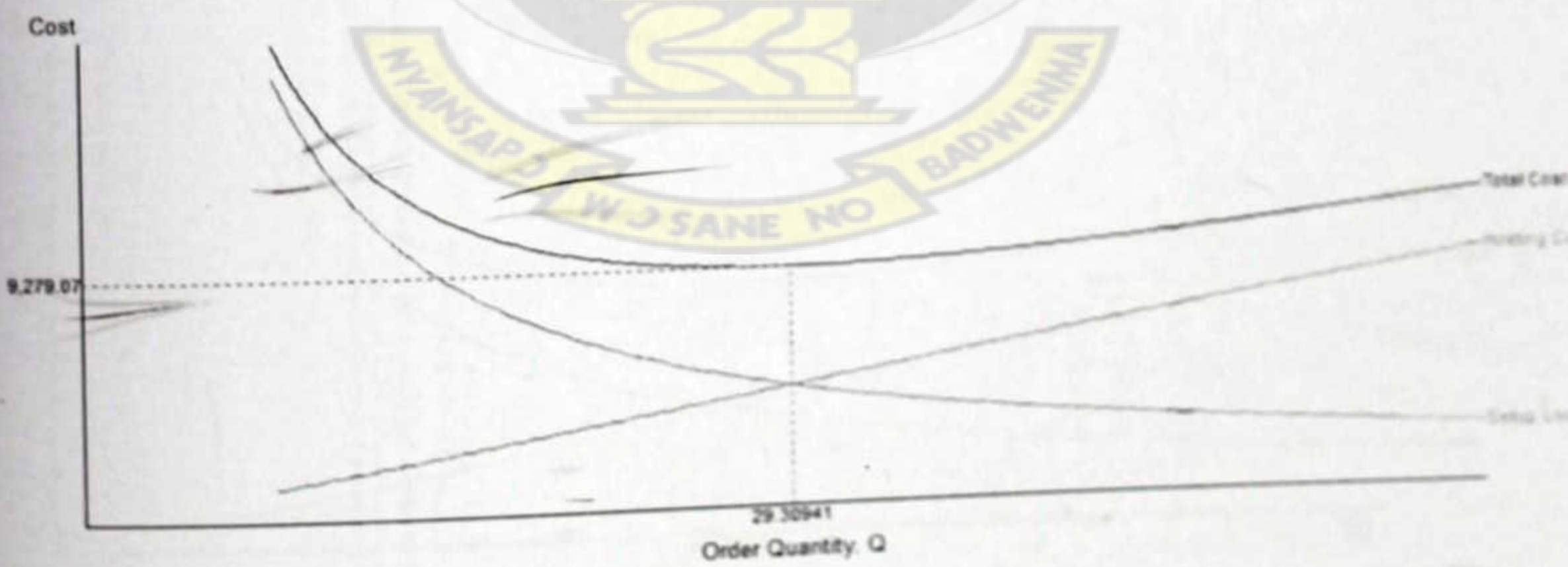


**Figure 4.35 Iron III (Cap Haematonics)**
**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Iron III (Cap Haematonics) for the year is 29.31 units whereas it will cost the hospital GH¢9,279.07.

### 4.1.36 Lidocaine 2%

Annual Demand = 413.4

Ordering Cost Per Unit = 1.4

Carrying Cost Per Unit = 413.4/728=0.58

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 413.04 \times 1.4}{0.58}}$$

$$Q = \sqrt{\frac{1156.512}{0.58}}$$

$$Q = \sqrt{1993.986206}$$

Q = 44.67 units

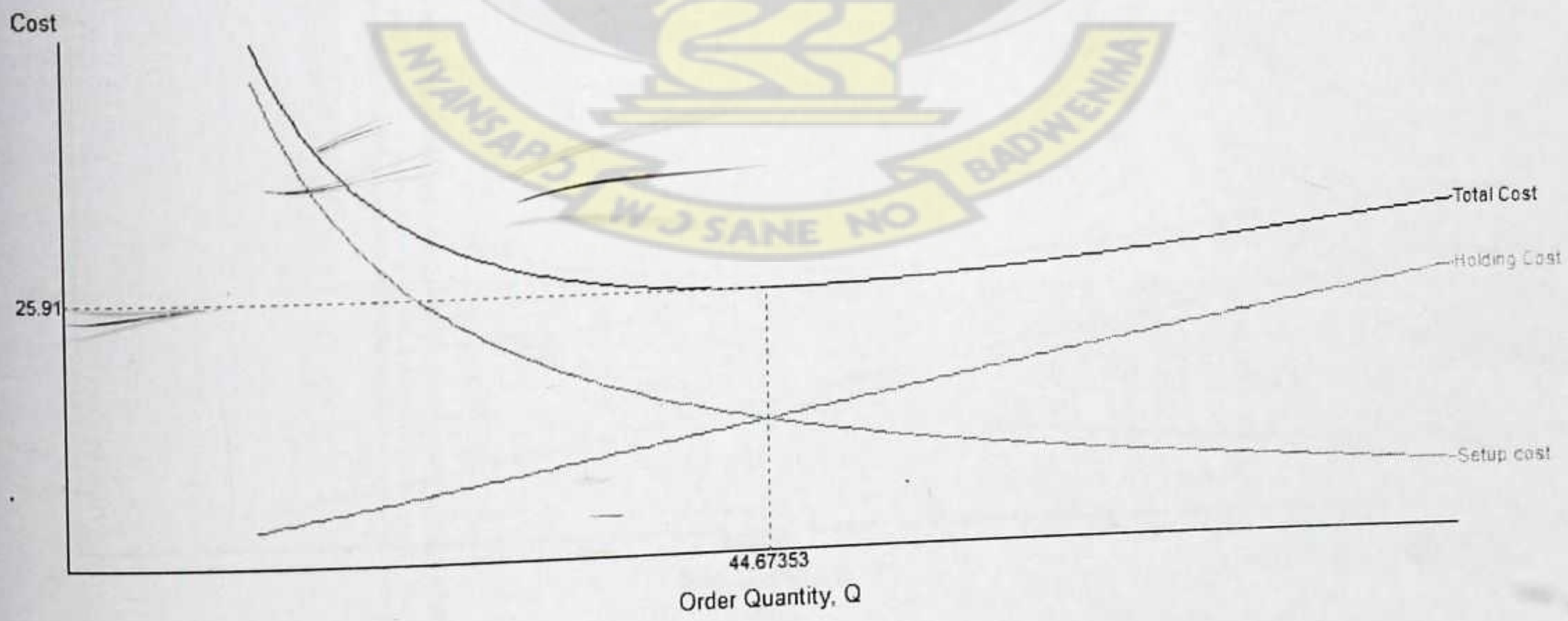


**Figure 4.36 Lidocaine 2%**
**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Lidocaine 2% for the year is 44.67 units whereas it will cost the hospital GH¢25.91

### 4.1.37 Loperamide 2mg

Annual Demand = 8124

Ordering Cost Per Unit = 0.19

Carrying Cost Per Unit = 8124/728=11.14

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 8124 \times 0.19}{11.14}}$$

$$Q = \sqrt{\frac{3087.12}{11.14}}$$

$$Q = \sqrt{277.120287}$$

Q = 16.65 units

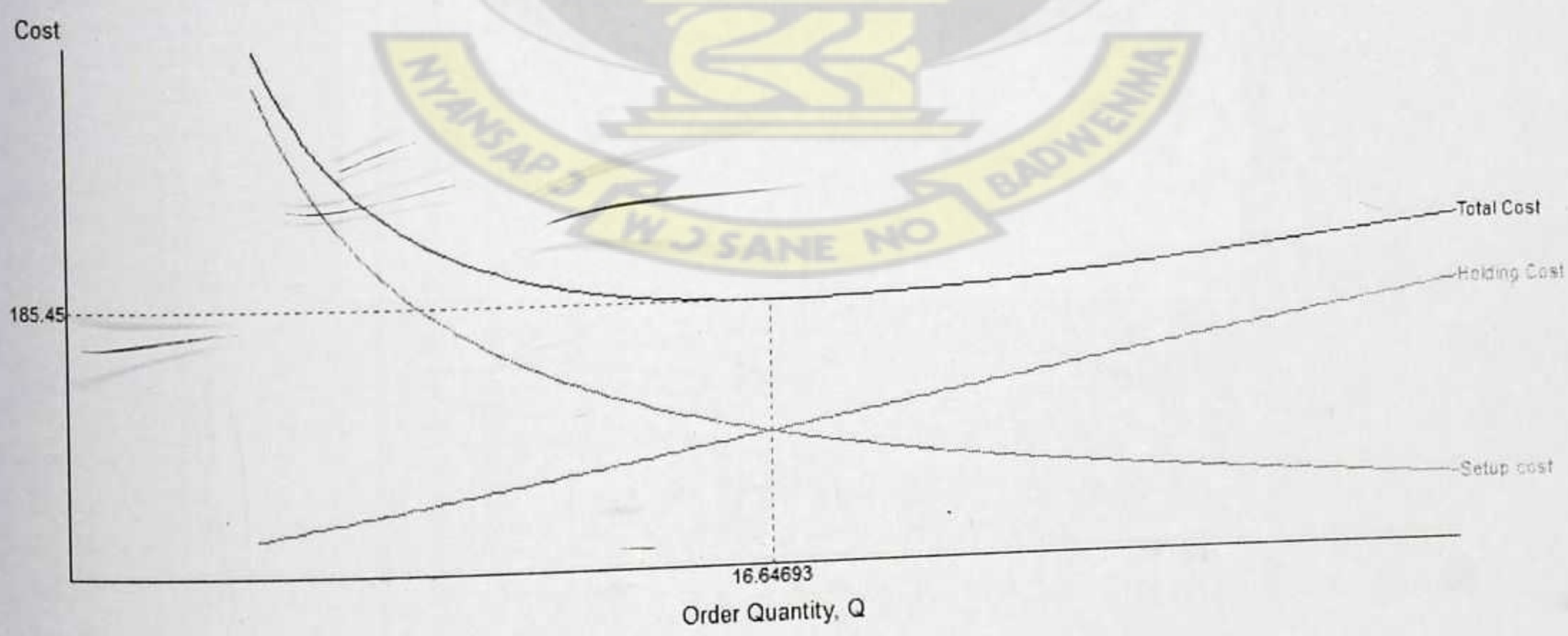


**Figure 4.37 Loperamide 2mg**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Lidocaine 2% for the year is 16.65 units whereas it will cost the hospital GH¢185.45

### 4.1.38 Oral Rehydration Salt (ORS)

Annual Demand = 11124

Ordering Cost Per Unit = 0.13

Carrying Cost Per Unit = 11124/728=15.28

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 11124 \times 0.13}{15.28}}$$

$$Q = \sqrt{\frac{2892.24}{15.28}}$$

$$Q = \sqrt{189.282722}$$

Q = 13.76 units

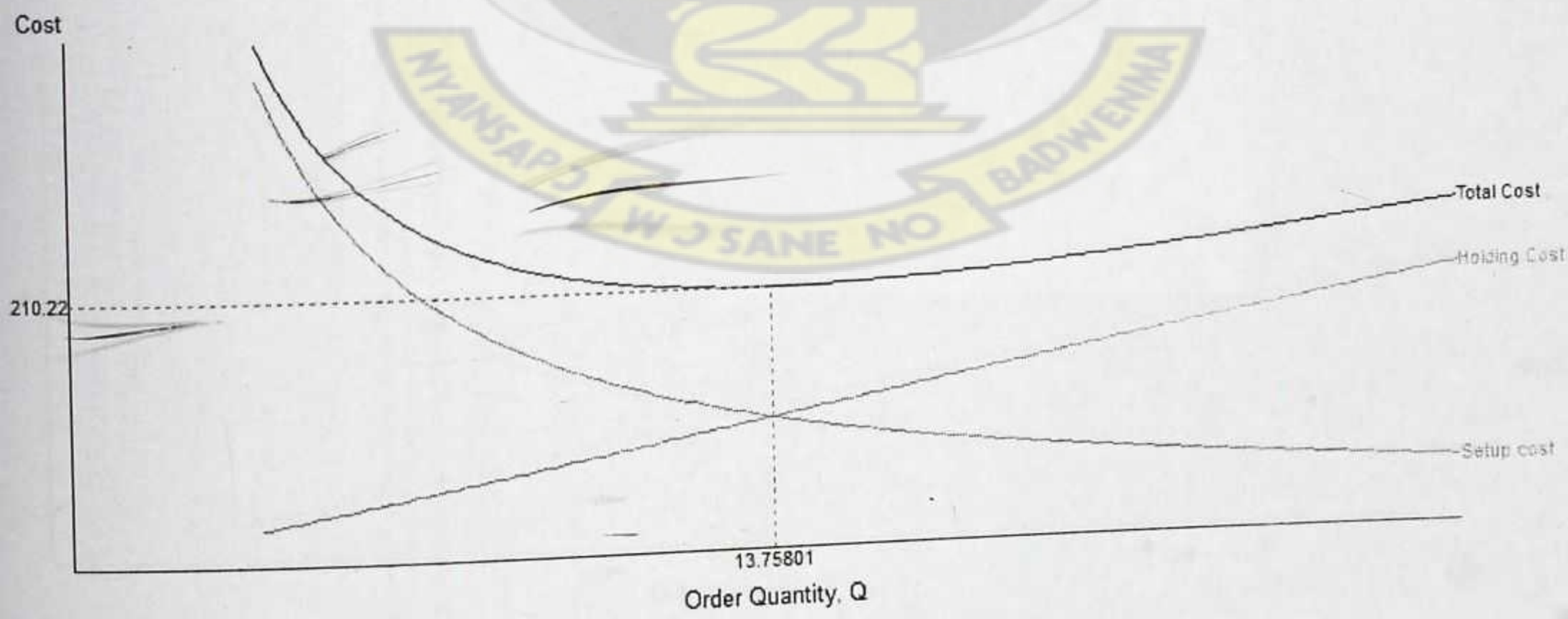


**Figure 4.38 Oral Rehydration Salt (ORS)**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Oral Rehydration Salt (ORS) for the year is 13.76 units whereas it will cost the hospital GH¢210.22

### 4.1.39 Povidone Iodine Solution

Annual Demand = 396.8

Ordering Cost Per Unit = 1.72

Carrying Cost Per Unit = 396.8/728=0.55

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 396.8 \times 1.72}{0.55}}$$

$$Q = \sqrt{\frac{1364.992}{0.55}}$$

$$Q = \sqrt{2481.80363636363}$$

Q = 49.82 units

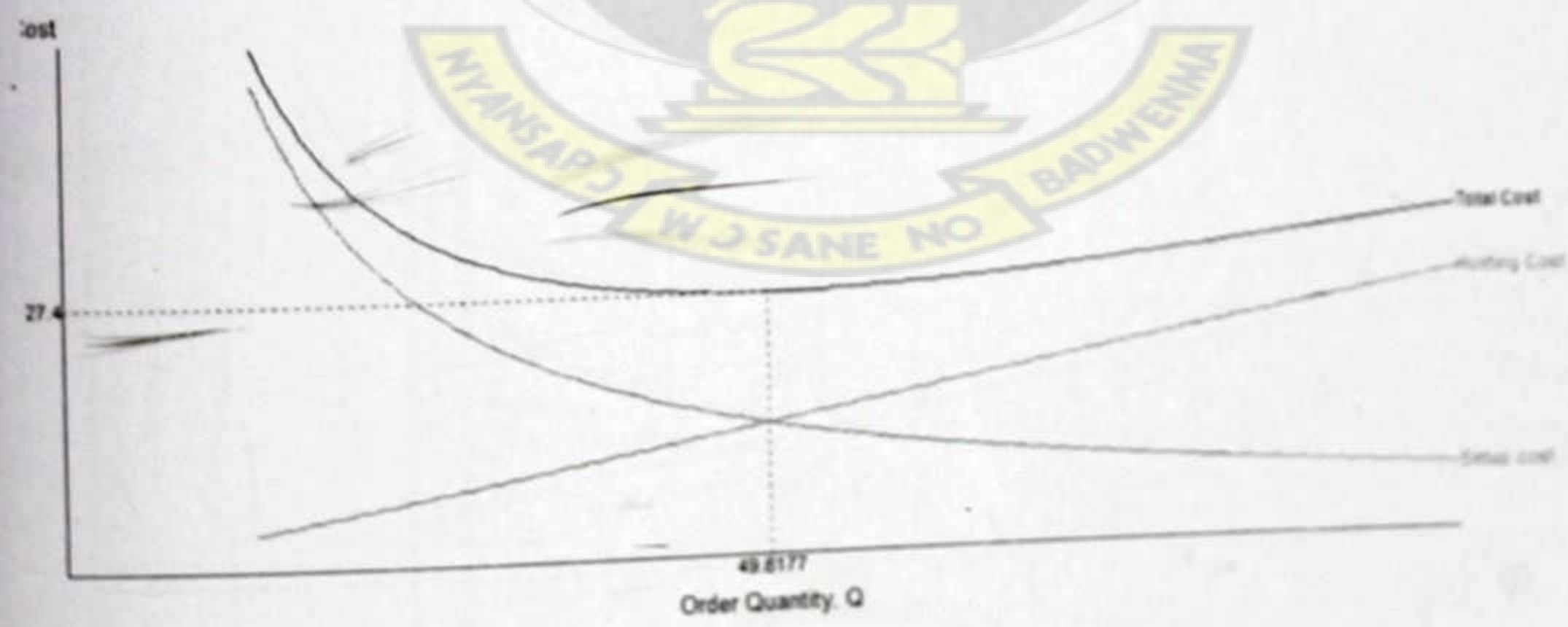


**Figure 4.39 Povidone Iodine Solution**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Povidone Iodine Solution for the year is 49.82 units whereas it will cost the hospital GH¢27.4.

### 4.1.40 Simple Linctus

Annual Demand = 9211.2

Ordering Cost Per Unit = 0.95

Carrying Cost Per Unit = 9211.2/728=12.65

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 9211.2 \times 0.95}{12.65}}$$

$$Q = \sqrt{\frac{17501.28}{12.65}}$$

$$Q = \sqrt{1383.500395}$$

Q = 37.20 units

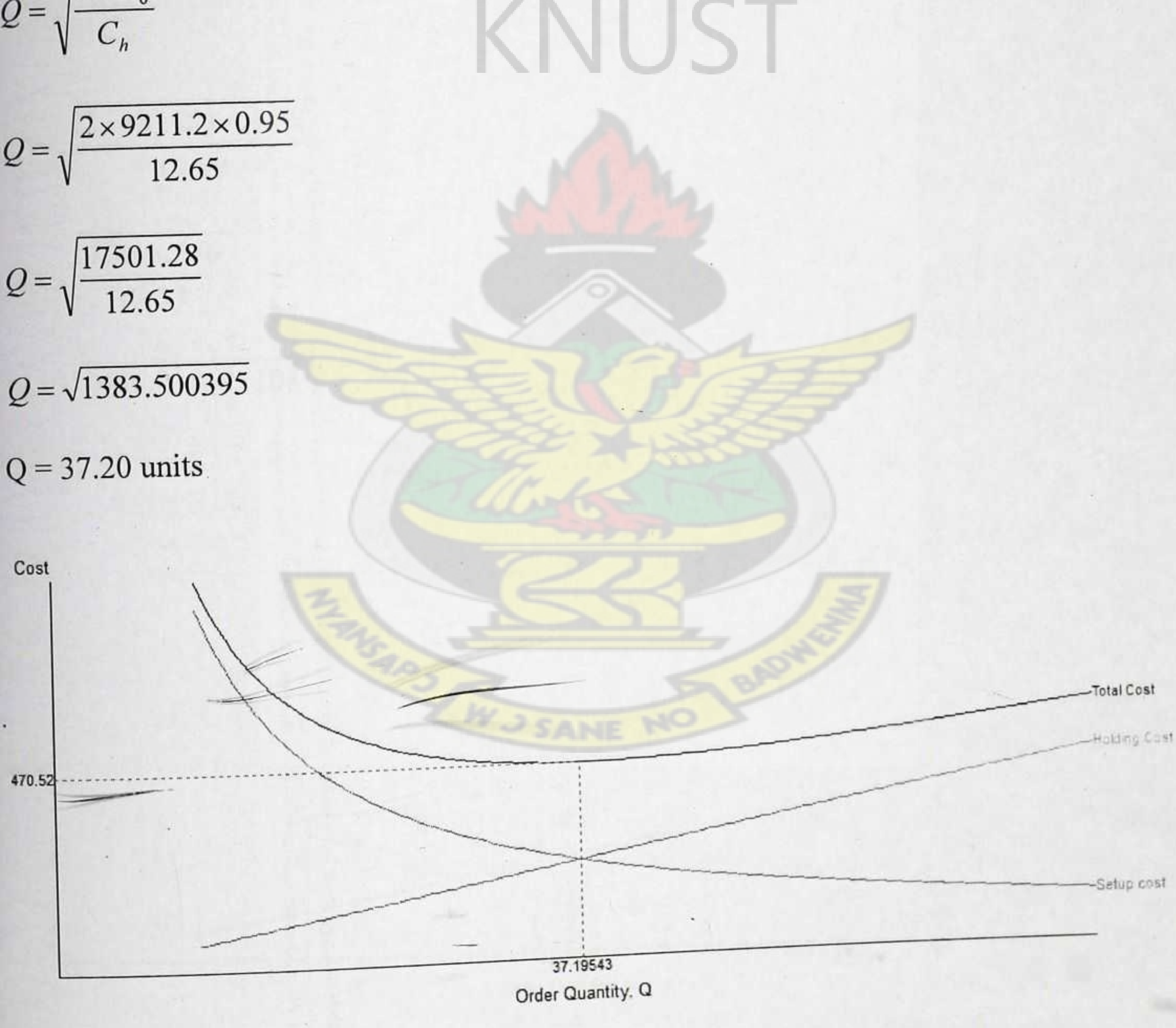


**Figure 4.40 Simple Linctus**
**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Simple Linctus for the year is 37.20 units whereas it will cost the hospital GH¢470.52

### 4.1.41 Susp. Haematonics (Iron III)

Annual Demand = 14246.6

Ordering Cost Per Unit = 1.68

Carrying Cost Per Unit = 14246.6/728=19.57

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 14246.6 \times 1.68}{19.57}}$$

$$Q = \sqrt{\frac{47868.576}{19.57}}$$

$$Q = \sqrt{2446.018191108}$$

Q = 49.46 units

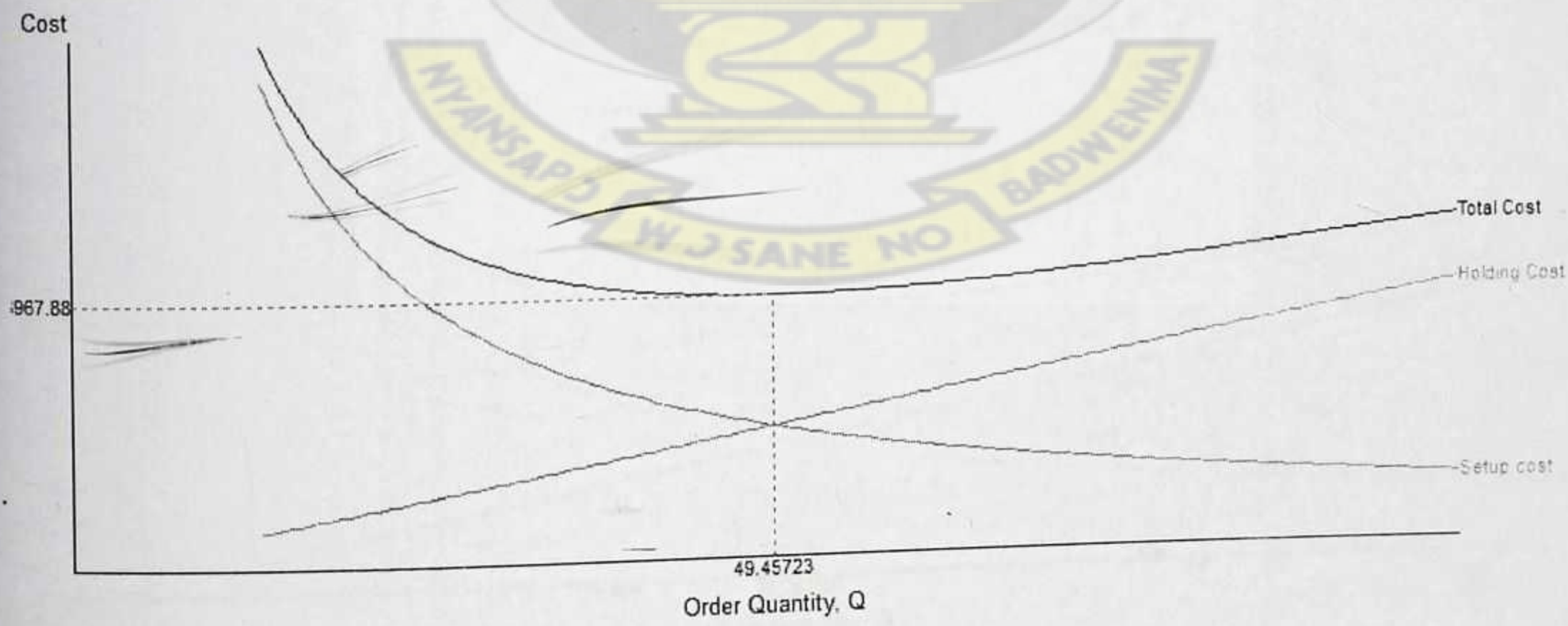


**Figure 4.41 Susp. Haematonics (Iron III)**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Susp. Haematonics (Iron III) for the year is 49.46 units whereas it will cost the hospital GH¢967.88

### 4.1.42 Syrup Liquid Parafin

Annual Demand = 157.2

Ordering Cost Per Unit = 1.67

Carrying Cost Per Unit = 157.2/728=0.22

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 157.2 \times 1.67}{0.22}}$$

$$Q = \sqrt{\frac{525.048}{0.22}}$$

$$Q = \sqrt{2386.5818181818}$$

Q = 48.85 units

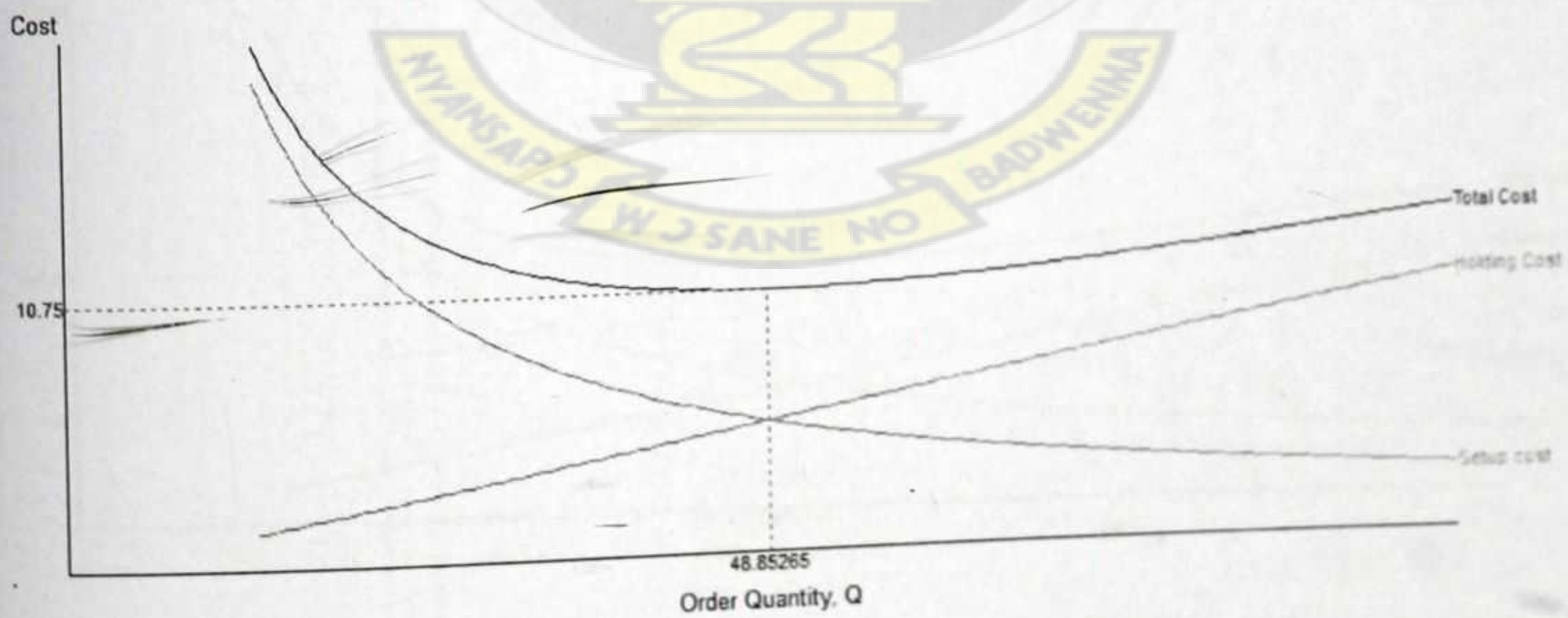


**Figure 4.42 Syrup Liquid Parafin**
**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Syrup Liquid Parafin for the year is 48.85 units whereas it will cost the hospital GH¢10.75

### 4.1.43 Tab Bendrofluazide 5mg

Annual Demand = 31100

Ordering Cost Per Unit = 0.01

Carrying Cost Per Unit = 31100/728=42.72

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 31100 \times 0.01}{42.72}}$$

$$Q = \sqrt{\frac{622}{42.72}}$$

$$Q = \sqrt{14.559925093}$$

Q = 3.82 units

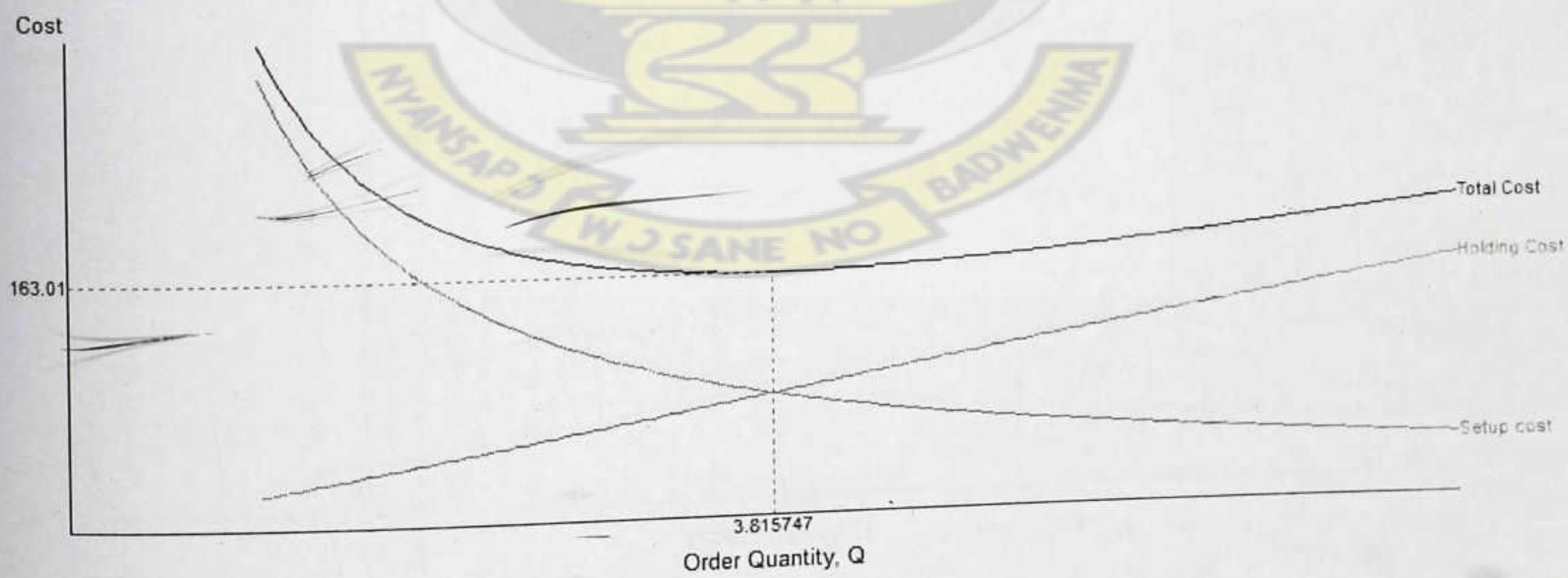


**Figure 4.43 Tab Bendrofluazide 5mg**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Tab Bendrofluazode 5mg for the year is 3.82 units whereas it will cost the hospital GH¢163.01

### 4.1.44 Tab Brufen 200mg (Ibuprofen)

Annual Demand = 129400

Ordering Cost Per Unit = 0.01

Carrying Cost Per Unit = 129400/728=177.74

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 129400 \times 0.01}{177.74}}$$

$$Q = \sqrt{\frac{2588}{177.74}}$$

$$Q = \sqrt{14.5609412625183}$$

Q = 3.82 units

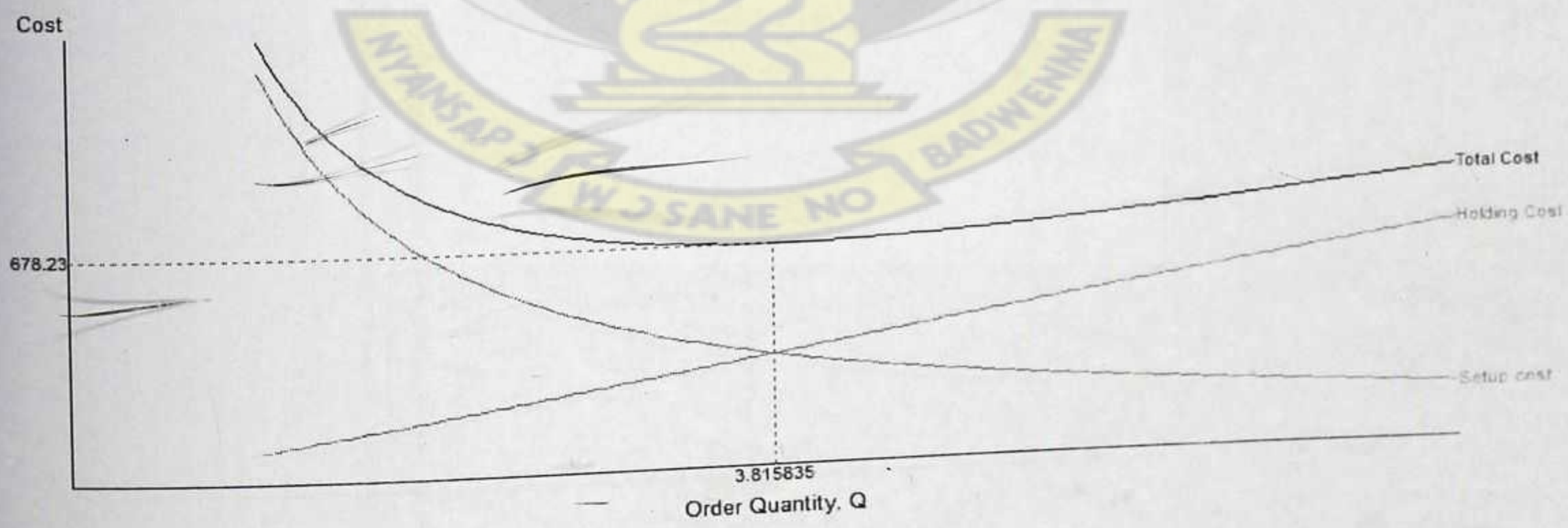


**Figure 4.44 Tab Brufen 200mg (Ibuprofen)**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Tab Brufen 200mg (Ibuprofen) for the year is 3.82 units whereas it will cost the hospital GH¢678.23

### 4.1.45 Tab Citrizine (Imunex) 10mg (Dihydrochloride)

Annual Demand = 31800

Ordering Cost Per Unit = 0.06

.Carrying Cost Per Unit = 31800/728=43.68

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 31800 \times 0.06}{43.68}}$$

$$Q = \sqrt{\frac{3816}{43.68}}$$

$$Q = \sqrt{87.362637362637736}$$

Q = 9.35 units

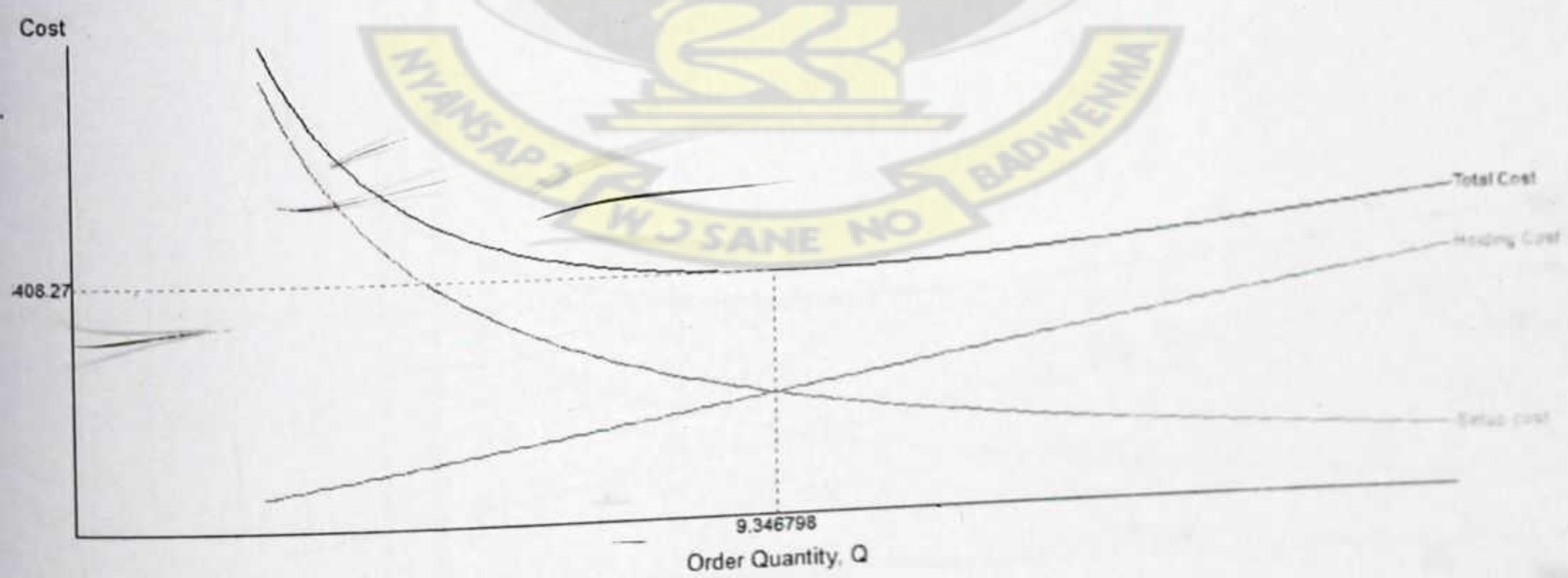


**Figure 4.45 Tab Citrizine (Imunex) 10mg (Dihydrochloride)**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Tab Citrizine (Imunex) 10mg (Dihydrochloride) for the year is 9.35 units whereas it will cost the hospital GH¢408.27

### 4.1.46 Tab Folic Acid 5mg

Annual Demand = 348200

Ordering Cost Per Unit = 0.004

Carrying Cost Per Unit = 348200/728=478.3

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 348200 \times 0.004}{478.3}}$$

$$Q = \sqrt{\frac{2785.6}{478.3}}$$

$$Q = \sqrt{5.82395987829814}$$

Q = 2.41 units

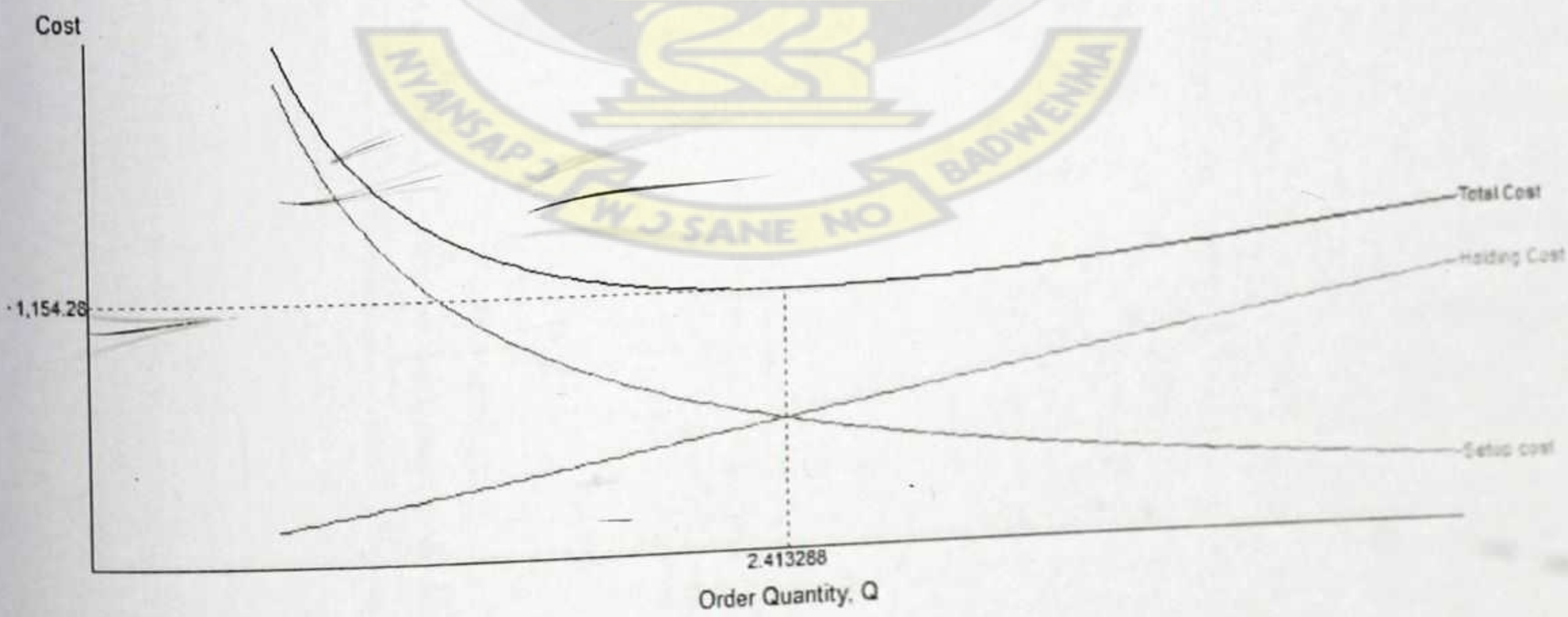


**Figure 4.46 Tab Folic Acid 5mg**
**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Tab Folic Acid 5mg for the year is 2.41 units whereas it will cost the hospital GH¢1154.28.

### 4.1.47 Tab Metformin 500g

Annual Demand = 149950.4

Ordering Cost Per Unit = 0.03

Carrying Cost Per Unit = 149950.4/728=205.98

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 149950.4 \times 0.03}{205.98}}$$

$$Q = \sqrt{\frac{8997.024}{205.98}}$$

$$Q = \sqrt{43.6791144771337}$$

Q = 6.61 units

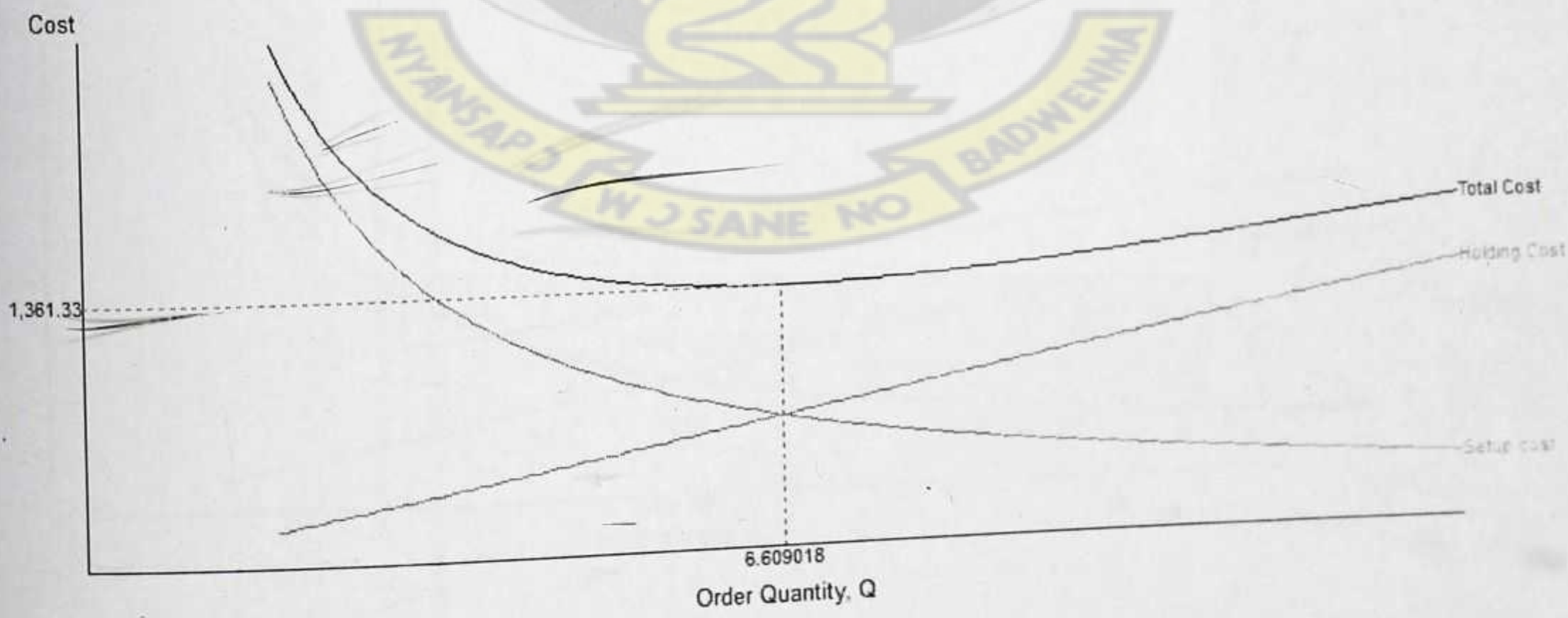


**Figure 4.47 Tab Metformin 500g**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Tab Metformin 500g for the year is 6.61 units whereas it will cost the hospital GH¢1,361.33.

### 4.1.48 Tab Lisinopril 10mg

Annual Demand = 25429

Ordering Cost Per Unit = 0.14

Carrying Cost Per Unit = 25429/728=34.93

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 25429 \times 0.14}{34.93}}$$

$$Q = \sqrt{\frac{7120.12}{34.93}}$$

$$Q = \sqrt{203.83967935871 74}$$

Q = 14.28 units

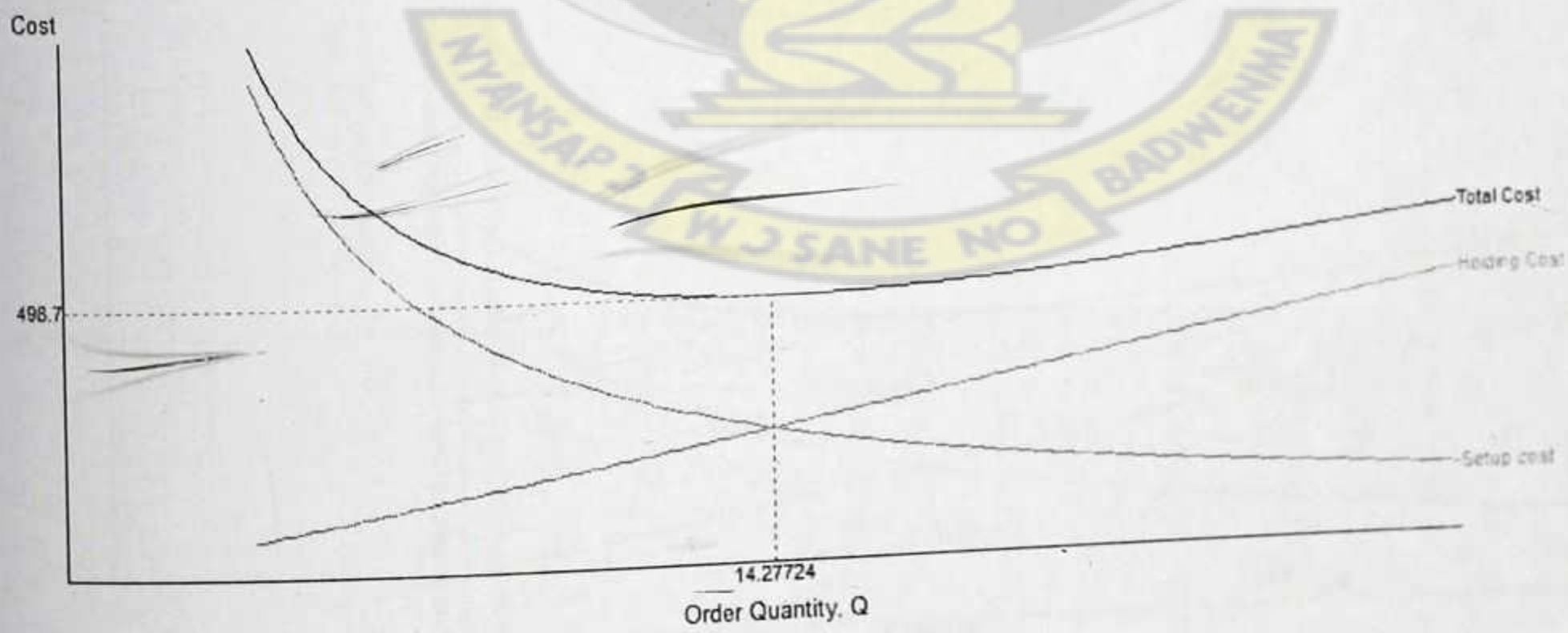


**Figure 4.48 Tab Lisinopril 10mg**

**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Tab Lisinopri 10mg for the year is 14.28 units whereas it will cost the hospital GH¢498.7

### 4.1.49 Vitamin B-Complex

Annual Demand = 396800

Ordering Cost Per Unit = 0.02

Carrying Cost Per Unit = 396800/728=545.05

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 396800 \times 0.02}{545.05}}$$

$$Q = \sqrt{\frac{15872}{545.05}}$$

$$Q = \sqrt{29.1202641959433}$$

Q = 5.40 units

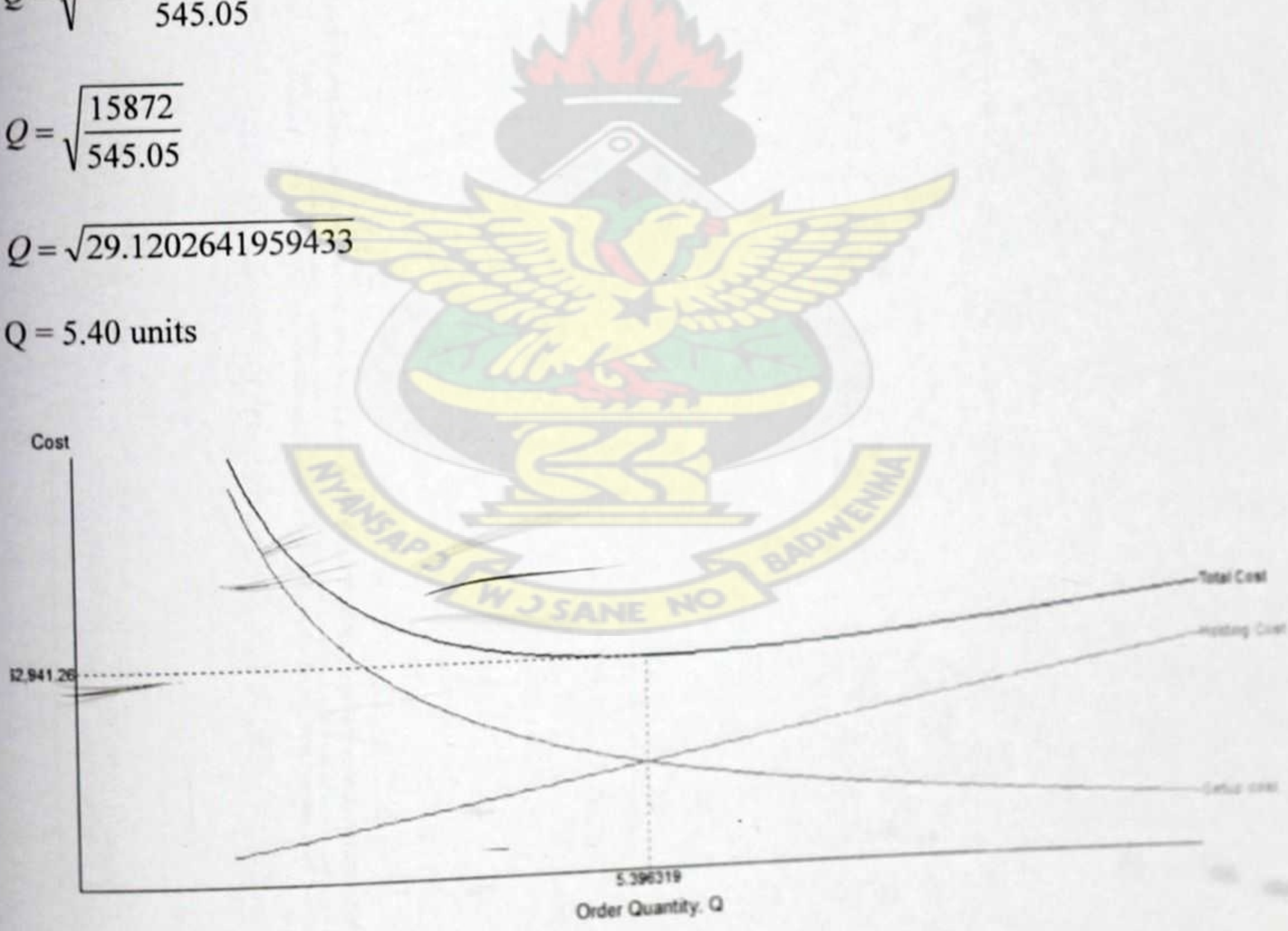


**Figure 4.49 Vitamin B-Complex**
**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Vitamin B-Complex for the year is 5.40 units whereas it will cost the hospital GH¢2,941.26.

### 4.1.50 Tab Vitamin C (Ascorbic Acid)

Annual Demand = 124440

Ordering Cost Per Unit = 0.005

Carrying Cost Per Unit = 124440/728=170.93

$$Q = \sqrt{\frac{2DC_0}{C_h}}$$

$$Q = \sqrt{\frac{2 \times 124440 \times 0.005}{170.93}}$$

$$Q = \sqrt{\frac{1244.4}{170.93}}$$

$$Q = \sqrt{7.280173170303633}$$

Q = 2.70 units

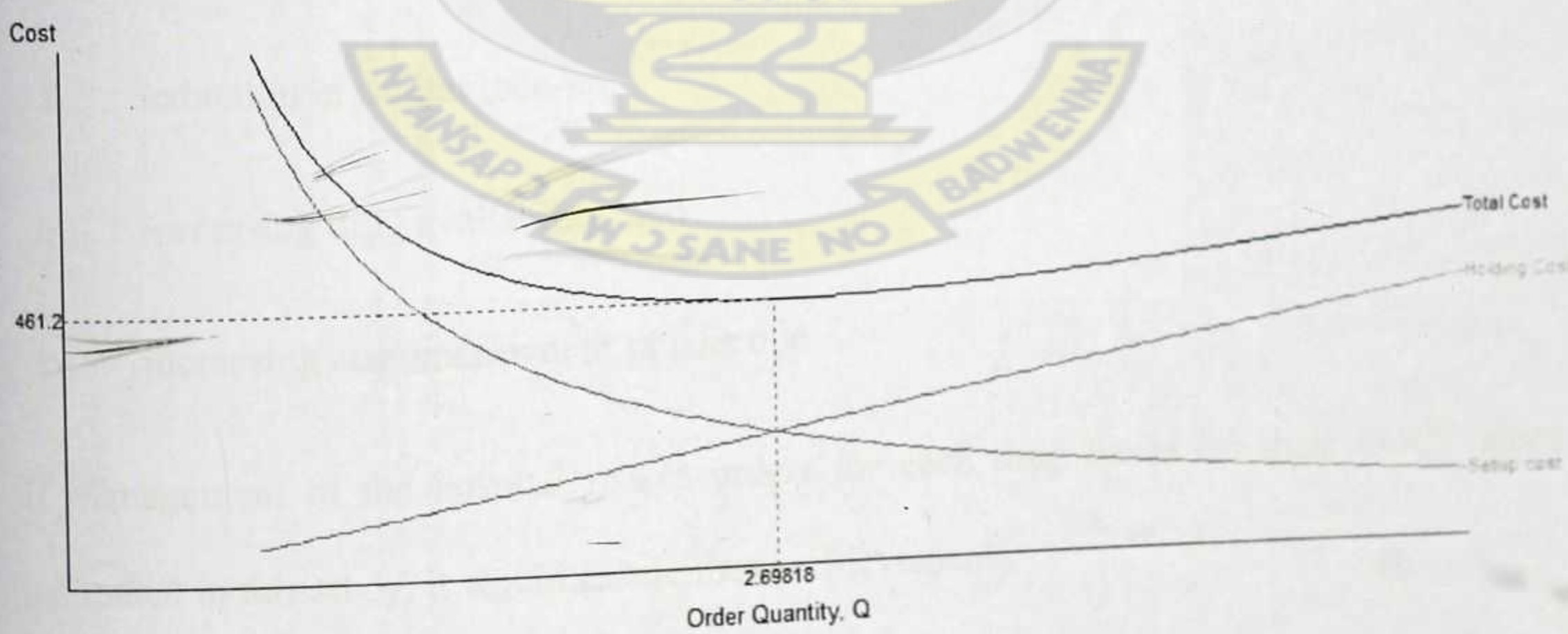


**Figure 4.50 Tab Vitamin C (Ascorbic Acid)**
**Source: (Field Study, 2012)**

From the above, it could be deduced that the EOQ of Tab Vitamin C Ascorbic Acid for the year is 2.70 units whereas it will cost the hospital GH¢461.2

## 4.2 Summary discussions

It was realised from the study that the hospital practises **two-bin system** for the period under review.

Comparing the optimal quantities and the total cost of each individual drug calculated using the EOQ model to the secondary data gathered, it was found that there are vast differences in values in terms of



i. the quantity of inventory that the organization holds/orders, and

ii. the cost associated with holding each item/drug

Holding the variables that affect the calculation of the optimal quantities constant, the hospital will realize enhance performance in term of

i. reducing stocks -outs,

ii. reduction in capital lock-up,

iii. increasing drug availability, and

iv. increasing customer/patient satisfaction.

If management of the hospital makes orders for each drug based on their EOQ values estimated in this study, it would ensure these achievements.

# CHAPTER FIVE

# SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

## 5.0 Introduction

This chapter seeks to present the findings, conclusions and recommendations of the research work. This section discusses the observations and some factors that are hindering the proper management of inventory in the hospital for efficient health care delivery.

## 5.1 Summary of Findings

### 5.1.1 Inventory Management Practice

From the analysis I realised that the Economic Order Quantity (EOQ) occurred since the total ordering cost equals the total holding cost and hence the hospital is practicing some form of inventory management system.

### 5.1.2 Calculation of EOQ of Essential Drugs

The EOQ model was used to estimate the annual optimal quantity of essential drugs at the Cape Coast Metropolitan hospital, ranging from tablets, syrups, capsules to injections. This was indicated with graphs for each drug showing the annual carrying cost, annual ordering costs and total inventory cost with their corresponding annual optimal quantity and associated cost. The optimal quantities for each drug were determined such that if the hospital employs these quantities per drug or health material they would ensure that the right quantities are kept and avoid stock outs.

## 5.2 Recommendations

This section discusses some suggestions from the author to help improve upon the inventory management practices in the hospital.

### 5.2.1 Use of EOQ to estimate optimal quantity of essential drugs

The hospital should make use of the EOQ model to estimate the annual demand for essential purposes so that they do not overstock drugs in their stores which may eventually expire or become obsolete. Therefore, there is the need to implement the model to determine the right quantities whiles bearing minimized costs of inventory. Especially, the annual carrying cost should be estimated to cover all costs associated with holding the drugs and other healthcare commodities in inventory.

### 5.2.2 Training of Inventory Management Staff

During the study it was revealed that training on inventory management has never been organised for workers. Hence, for the application of the EOQ model, there is the need to train the staffs to know the components of the model so that their knowledge would be advanced concerning the model. Refresher courses are something which should be organised for workers once in a while. When this is done at least once a year, it would help sharpen their skills as well as knowledge on what is going on as inventory management is concerned.

### 5.2.3 Improved Inventory Management Practice

It is recommended that the hospital adopt more than one system of managing inventory as this is a hospital where medical supplies ought to be always available. If items are reviewed periodically, there is the chance of obsolete supplies being eliminated and the possibility of larger quantity discounts obtained when a range of items are ordered at same time.

## 5.3 Conclusion

Inventory is a necessity in every organisation hence serious steps must be taken to manage it properly so that operations of the organisation will not come to a halt. From the analysis, it

is seen that inventory management practices clearly has a relationship with the efficiency of health care delivery. In improving inventory management in the hospital to translate on the efficient running of the hospital, it is definitely going to create a competitive edge by delivering quality medical supplies at the right time and offering lower cost by cutting its own cost as well as purchased items costs. The EOQ model, if well implemented would help ensure that the right quantity of drugs is held in stock to facilitate good healthcare delivery.

## References


Amoah, .S. K. and Yeboah, P. (2011), "*Purchasing and Supply Management in Ghana: the past and present*", Daily graphic, 9 February.p.19

Bryman, A. and Bell, E. (*2003*), "*Business Research Methods*", Oxford, Oxford University Press.

Chase, R.B., Jacobs, F. R., and Aquilano, N.J (2004),"*Operations Management for Competitive Advantage*", 10th ed. International edition. NY. Mcgraw Hill

Chopra S. (2007), "*Supply Chain Management*", 3rd ed. Pearson Education

Clodfelter, R. (2003), "*Retail buying from basics to fashion*", 2nd ed.USA.

Ghana Health Service. (2005), "*Annual Report*", Ministry of Health, Accra.

Gourdin, K. N. (2001), "*Global Logistics Management: A competitive advantage for the new millennium*", Blackwell business, USA

Hugo, W. M. J., Badenhorst-Weiss, J. A. and Van Rooyen, D. C. (2002), "*Purchasing and supply management*"4th ed. Pretoria: J.L Van Schaik Publishers.

Kinnear, T. C and Taylor, J. R. (1996), "*Marketing Research: An Applied Approach*", Fifth ed., New York: MGH, xxii, p 888.

Lucey T. (2002), "*Quantitative Techniques*, 6th ed. UK. Elst.

Mishra, (2007), "*The Basics of Production – Inventory Management Information*", 9ed Kinbal publisher.

Mishra, R. (2007), "*Materials Management*", New Delhi: Anurag Jain.

Monczka et al (2010), "*Purchasing and Supply Management*" South-Western/Congage

Monks, J.G. (1996), "*Schaum's outline of theory and problems of operations management*", 2nd ed. Mcgraw Hill

Reid R. D. and Sanders N. R. (2007), "*Operations Management: An Integrated Approach*", 3rd Ed.

Reid, R.D. and Sanders, N.R. (2007), "*Operations Management*", 3rd ed. UK, John Wiley and Sons, Inc.

Saunders, M., Lewis, P., Thornhill, A. (2004), "*Research Methods for Business Students*", FT-Prentice-Hall

Sharma, A.K. (2006), "*Purchasing and Materials Management*" New Delhi. Anmol Publications Pvt. Ltd.

Waters, D. (2003), "*Inventory Control and Management*", 2nd ed. Chichester: John Wiley and Sons.

Wild, J. (2002), "*Best practice in inventory management*" 2nd ed. UK. Butterworth-Heinemann.

**Internet Sites**

www.en.wikipeida.org/ wiki / Inventory Management, accessed 22/01/201219:00 PM

www.sentinthealth.com/en/casestudies.php

www.cathlabdigest.com/article/2570

www.inventorymanagement.com

www.barcoding.com/industry/healthcare/hospital.shtml

www.asianhhm.com/knowledge bank/articles/materials-management-healthcare.html

**Appendix I**

| DRUG | QUANTITY DEMANDED IN A YEAR | | | | |
|---|---|---|---|---|---|
| | **2007** | **2008** | **2009** | **2010** | **2011** |
| 1. Syrup Multivitamin | 9614 | 3336 | 2410 | 3840 | 5140 |
| 2. Paracetamol supp. 125mg | 7400 | 4500 | 47600 | 39100 | 37710 |
| 3. Amlodipine 5mg (Tab) | 27000 | 79200 | 66050 | 60048 | 59378 |
| 4. Injuction Pellidins 100mg | 4217 | 3440 | 730 | 1710 | 706 |
| 5. Tab Nifodipone 20mg | 194000 | 144600 | 163000 | 160,000 | 103900 |
| 6. Syrup Flagyl (Metronidazole) | 2490 | 2040 | 2600 | 1602 | 1832 |
| 7. Timolol (Eye drop) 0.5% | 625 | 1200 | 870 | 1120 | 681 |
| 8. Salbutamol (syrup) 200ml | 240 | 143 | 120 | 180 | 145 |
| 9. Syrup Erythromycin 125mg/5ml | 800 | 1420 | 1915 | 1470 | 1620 |
| 10. Syrup Flucloxacillin | 2436 | 3044 | 1759 | 1940 | 2044 |
| 11. Cap clindamycin 150mg | 10,000 | 7000 | 24000 | 15800 | 21900 |
| 12. Tab Prednisoline 5mg | 1000 | 14000 | 33000 | 24000 | 22350 |
| 13. Inj. Hydrocortisone 100mg | 2050 | 1300 | 1720 | 1500 | 810 |
| 14. Tab Amlodipine 10mg | 37000 | 88000 | 70550 | 62672 | 92180 |
| 15. Susp. Amoxyl (Amoxycillin) | 3226 | 5840 | 5048 | 4820 | 4379 |
| 16. Cap Amoxyl (Amoxycillin) 250mg | 190,000 | 388,000 | 235,000 | 211,000 | 358,000 |
| 17. Tab Buscopan 10mg (Hyoscine Butyl Bromide | 640000 — | 495000 | 48500 | 34000 | 26000 |
| 18. Tab Paracetamol 500mg | 454000 | 601000 | 823000 | 65500 | 875000 |
| 19. Tab Cefuroxime (zinnat) 250mg | 15526 | 25800 | 22300 | 15400 | 3200 |

| | | | | | |
|---|---|---|---|---|---|
| 20. Inj. X-Pen (Benzyl Penicillin Imu) | 4700 | 5400 | 145720 | 93506 | 167424 |
| 21. Susp. Albendazole 400mg | 940 | 247 | 2467 | 2280 | 1740 |
| 22. Chlorpheneranine 4mg | 20000 | 57000 | 53000 | 34000 | 28000 |
| 23. Calamine Ointment | 600 | 240 | 100 | 270 | 280 |
| 24. Magnesium Tricilicate+Aluminium Hydroxide Mix. | 3072 | 1391 | 3260 | 3650 | 3678 |
| 25. Tab Multivite | 425350 | 400600 | 257000 | 330000 | 417000 |
| 26. Tab Bendrofluazode 5mg | 19000 | 34500 | 28500 | 28000 | 45500 |
| 27. Vitamin B-complex | 350,000 | 334,000 | 556,000 | 366,000 | 378,000 |
| 28. Tab Folic Acid 5mg | 210,000 | 235000 | 552,000 | 366,000 | 378000 |
| 29. Tab Brufen 200mg (Ibuprofen) | 199000 | 204000 | 42500 | 80500 | 121000 |
| 30. Cotrimoxazole 480mg | 97000 | 70000 | 48000 | 60000 | 79000 |
| 31. Ascorbic Acid | 134000 | 114000 | 172000 | 107000 | 95200 |
| 32. Cap Tramadol 50mg | 10,000 | 10700 | 12000 | 14800 | 14000 |
| 33. Azithromycin 250mg | 1470 | 6768 | 3498 | 9600 | 2180 |
| 34. Tab Citrizine (Imunex) 10mg (Dihydrochloride) | 27800 | 51000 | 22000 | 27900 | 30300 |
| 35. Susp. Haematonics (Iron III) | 5680 | 18945 | 18138 | 13364 | 15106 |
| 36. Inj. Diclofenac 75mg | 9980 | 8310 | 8840 | 3800 | 3216 |
| 37. Simple Linctus | 4897 | 10504 | 12032 | 8103 | 10520 |
| 38. Syrup Liquid Parafin | 200 | 106 | 100 | 160 | 220 |
| 39. Diclofenac Gel 30g | 1120 | 2000 | 3686 | 2844 | 3220 |
| 40. Tab Metformin 500g | 183500 | 159602 | 145720 | 93506 | 167424 |

| | | | | | |
|---|---|---|---|---|---|
| 41. Flucloxacillin Capsules 250mg | 133,000 | 138,000 | 128,000 | 117,500 | 112,000 |
| 42. Oral Rehydration Salt | 9550 | 9212 | 12890 | 9640 | 14328 |
| 43. Lidocaine 2% | 665 | 556 | 368 | 190 | 288 |
| 44. Amoxicillin + Clavulanic Acid | 18731 | 42092 | 34204 | 24920 | 20767 |
| 45. Decatylene Lozenges | 2000 | 2200 | 1240 | 1500 | 6104 |
| 46. Povidone Iodine Solution | 200 | 90 | 640 | 500 | 554 |
| 47. Loperamide 2mg | 14400 | 12600 | 6000 | 4660 | 2960 |
| 48. Frusemide 40mg | 26000 | 32000 | 30000 | 20000 | 18500 |
| 49. Iron III (Cap. Haematonics) | 88800 | 296700 | 306900 | 219480 | 240510 |
| 50. Tab Lisinopril 10mg | 20024 | 44392 | 26540 | 19642 | 16548 |

**Appendix II**

| DRUG | QUANTITY ISSUED IN A YEAR | | | | |
|---|---|---|---|---|---|
| | 2007 | 2008 | 2009 | 2010 | 2011 |
| 1. Syrup Multivitamin | 9278 | 2076 | 2410 | 2940 | 3590 |
| 2. Paracetamol supp. 125mg | 4100 | 3900 | 9500 | 16700 | 28610 |
| 3. Amlodipine 5mg (Tab) | 22800 | 48900 | 66050 | 59828 | 52000 |
| 4. Injuction Pellidins 100mg | 3597 | 3430 | 730 | 1504 | 685 |
| 5. Tab Nifodipone 20mg | 136,000 | 144600 | 98000 | 125,000 | 103900 |
| 6. Syrup Flagyl (Metronidazole) | 1650 | 1740 | 1928 | 1366 | 1482 |
| 7. Timolol (Eye drop) 0.5% | 425 | 700 | 870 | 1020 | 521 |
| 8. Salbutamol (syrup) 200ml | 97 | 63 | 120 | 110 | 135 |
| 9. Syrup Erythromycin 125mg/5ml | 380 | 706 | 835 | 810 | 1020 |
| 10. Syrup Flucloxacillin | 1572 | 1608 | 1759 | 1556 | 1564 |
| 11. Cap clindamycin 150mg | 4500 | 6700 | 11900 | 15600 | 13200 |
| 12. Tab Prednisoline 5mg | 1000 | 14000 | 17000 | 20000 | 21050 |
| 13. Inj. Hydrocortisone 100mg | 1450 | 1200 | 820 | 1270 | 654 |
| 14. Tab Amlodipine 10mg | 24000 | 55600 | 70550 | 62672 | 92180 |
| 15. Susp. Amoxyl (Amoxycillin) | 2726 | 3872 | 3168 | 3391 | 3239 |
| 16. Cap Amoxyl (Amoxycillin) 250mg | 190000 | 333000 | 127000 | 143000 | 240,000 |
| 17. Tab Buscopan 10mg (Hyoscine Butyl Bromide | 335000 | 45000 | 32500 | 29000 | 26000 |
| 18. Tab Paracetamol 500mg | 408,000 | 601,000 | 622000 | 576,000 | 693500 |
| 19. Tab Cefuroxime (zinnat) 250mg | 9726 | 20700 | 19600 | 15400 | 3200 |

| | | | | | |
|---|---|---|---|---|---|
| 20. Inj. X-Pen (Benzyl Penicillin Imu) | 3300 | 5100 | 137220 | 93506 | 147924 |
| 21. Susp. Albendazole 400mg | 940 | - | 1717 | 1380 | 1425 |
| 22. Chlorpheneranine 4mg | 13000 | 6000 | 27000 | 24000 | 17000 |
| 23. Calamine Ointment | 560 | 240 | 100 | 210 | 210 |
| 24. Magnesium Tricilicate+Aluminium Hydroxide Mix. | 1681 | 1391 | 2600 | 1560 | 2678 |
| 25. Tab Multivite | 324750 | 313600 | 189000 | 302000 | 332000 |
| 26. Tab Bendrofluazode 5mg | 15,000 | 19,000 | 28500 | 25500 | 41000 |
| 27. Vitamin B-complex | 321,000 | 330000 | 390,000 | 305000 | 230,000 |
| 28. Tab Folic Acid 5mg | 190,000 | 219,000 | 437000 | 293000 | 326,000 |
| 29. Tab Brufen 200mg (Ibuprofen) | 135,000 | 150,000 | 20,000 | 80500 | 101500 |
| 30. Cotrimoxazole 480mg | 27000 | 42000 | 48000 | 44000 | 62000 |
| 31. Ascorbic Acid | 105,000 | 102000 | 88000 | 91000 | 86200 |
| 32. Cap Tramadol 50mg | 8300 | 6400 | 11100 | 8400 | 11500 |
| 33. Azithromycin 250mg | 1302 | 3390 | 3498 | 9100 | 2180 |
| 34. Tab Citrizine (Imunex) 10mg (Dihydrochloride) | 16800 | 33700 | 22000 | 20600 | 27500 |
| 35. Susp. Haematonics (Iron III) | 1935 | 18866 | 11538 | 11564 | 8998 |
| 36. Inj. Diclofenac 75mg | 6470 | 5890 | 5640 | 3800 | 2496 |
| 37. Simple Linctus | 4393 | 6945 | 7028 | 6423 | 5880 |
| 38. Syrup Liquid Parafin | 144 | 106 | 100 | 50 | 90 |
| 39. Diclofenac Gel 30g | 1120 | 1890 | 1454 | 2464 | 3220 |
| 40. Tab Metformin 500g | 90,404 | 135,128 | 1372200 | 935006 | 147924 |

| | | | | | |
|---|---|---|---|---|---|
| 41. Flucloxacillin Capsules 250mg | 100,000 | 131000 | 81500 | 108500 | 106000 |
| 42. Oral Rehydration Salt | 8800 | 9215 | 10150 | 6740 | 11328 |
| 43. Lidocaine 2% | 317 | 374 | 200 | 178 | 251 |
| 44. Amoxicillin + Clavulanic Acid | 11951 | 36611 | 34504 | 34204 | 21518 |
| 45. Decatylene Lozenges | 300 | 2200 | 1240 | 1300 | 3880 |
| 46. Povidone Iodine Solution | 110 | 90 | 640 | 266 | 449 |
| 47. Loperamide 2mg | 1800 | 9200 | 4900 | 2800 | 2900 |
| 48. Frusemide 40mg | 24000 | 2000 | 17000 | 17000 | 12500 |
| 49. Iron III (Cap. Haematonics) | 32100 | 261420 | 273900 | 186960 | 205620 |
| 50. Tab Lisinopril 10mg | 7132 | 22392 | 25070 | 17290 | 16548 |

## APPENDIX III

| DRUG | QUANTITY ON HAND IN A YEAR | | | | |
|---|---|---|---|---|---|
| | 2007 | 2008 | 2009 | 2010 | 2011 |
| 1. Syrup Multivitamin | 336 | 1260 | - | 900 | 1550 |
| 2. Paracetamol Supp. 125mg | 3300 | 600 | 38100 | 22400 | 9100 |
| 3. Amlodipine 5mg (Tab) | 4200 | 30,300 | - | 220 | 7378 |
| 4. Injection Pethidins 100mg | 620 | 10 | - | 206 | 21 |
| 5. Tab Nifidipine 20mg | 58000 | - | 65000 | 35,000 | - |
| 6. Syrup Flagyl (metronidazole) | 840 | 300 | 672 | 236 | 350 |
| 7. Timolol (Eye drop) 0.5% | 200 | 500 | - | 100 | 160 |
| 8. Salbutamol (syrup) 200ml | 143 | 80 | - | 70 | 10 |
| 9. Syrup Erythromycin 125mg/5ml | 420 | 714 | 1080 | 660 | 600 |
| 10. Syrup Flucloxacillin | 864 | 1436 | - | 384 | 480 |
| 11. Cap Clindamycin 150mg | 5500 | 300 | 12100 | 200 | 8700 |
| 12. Tab Prednisolone 5mg | - | - | 16000 | 4000 | 1300 |
| 13. Inj. Hydrocortisone 100mg | 600 | 100 | 900 | 230 | 156 |
| 14. Tab Amlodipine 10mg | 13000 | 32400 | - | - | - |
| 15. Susp. Amoxyl (Amoxacillin) | 500 | 1968 | 1880 | 1429 | 1140 |

| | | | | | |
|---|---|---|---|---|---|
| 16. Cap Amoxyl 250mg (Amoxacillin) | - | 55,000 | 108000 | 68000 | 118000 |
| 17. Tab Buscopan 10mg (Hyoscine Butyl Bromide) | 30,500 | 4500 | 16000 | 5000 | - |
| 18. Tab Paracetamol 500mg | 46000 | - | 201000 | 79000 | 181500 |
| 19. Tab Cefuroxime (Zinnate) 250mg | 5800 | 5100 | 2700 | - | - |
| 20. Inj. X-Pen (Benzyl Penicillin Imu) | 1400 | 300 | 8500 | - | 19500 |
| 21. Susp. Albendazole 400mg | - | 247 | 750 | 900 | 315 |
| 22. Chlorpheneranine 4mg | 7000 | 51000 | 26000 | 10000 | 11000 |
| 23. Calamine Ointment | 40 | - | - | 60 | 70 |
| 24. Magnesium Tricilicate + Aluminium Hydroxide Mixture | 1391 | - | 660 | 2090 | 1000 |
| 25. Tab Multivite | 100600 | 87000 | 68000 | 28000 | 85000 |
| 26. Tab Bendrofluazide 5mg | 4000 | 15500 | - | 2500 | 4500 |
| 27. Vitamin B-Complex | 29000 | 4000 | 166000 | 51000 | 72000 |
| 28. Tab Folic Acid 5mg | 20,000 | 16000 | 115000 | 73000 | 52000 |
| 29. ~~Tab~~ Brufen 200mg (Ibuprofen) | 64000 | 54000 | 22500 | - | 19500 |
| 30. Cotrimoxazole 480mg | 70,000 | 28000 | - | 16000 | 17000 |
| 31. Ascobic Acid | 29000 | 12000 | 84000 | 16000 | 9000 |
| 32. Cap Tramadol 50mg | 1700 | 4300 | 900 | 6400 | 2500 |

| | | | | | |
|---|---|---|---|---|---|
| 33. Azithromycin 250mg | 168 | 3378 | - | 500 | - |
| 34. Tab Citrizine (Imunex) 10mg | 11000 | 17300 | - | 7300 | 2800 |
| 35. Susp. Haematonics (Iron III) | 3745 | 79 | 6600 | 1800 | 6108 |
| 36. Inj. Diclofenac 75mg | 3510 | 2420 | 3200 | - | 720 |
| 37. Simple Linctus | 504 | 3559 | 5004 | 1680 | 4640 |
| 38. Syrup Liquid Parafin | 56 | - | - | 110 | 130 |
| 39. · Diclofenac Gel 30g | - | 110 | 2232 | 380 | - |
| 40. Tab Metformin 500mg | 93046 | 24474 | 8500 | - | 19500 |
| 41. Tab Flucloxaxillin Capsules 250mg | 33000 | 7000 | 46500 | 9000 | 6000 |
| 42. Oral Rehydration Salt | 750 | - | 2740 | 2900 | 3000 |
| 43. Lidocaine 2% | 348 | 182 | 168 | 12 | 37 |
| 44. Amoxycillin + Clavulanic Acid | 6780 | 5481 | - | 3402 | - |
| 45. Decatylene Lozenges | 1700 | - | - | 200 | 2224 |
| 46. Povidone Iodine Solution | 90 | - | - | 234 | 105 |
| 47. Loperamide 2mg | 12600 | 3400 | 1100 | 1860 | 60 |
| 48. Frusemide 40mg | 2000 | 30000 | 13000 | 3000 | 6000 |
| 49. Iron III (Cap. Haematonics) | 56700 | 35280 | 33000 | 32520 | 34950 |
| 50. Tab. Lisinopril 10mg | 12892 | 22000 | 1470 | 2352 | - |

**Appendix IV**

| DRUG | PURCHASE COST PER UNIT (IN GH¢) | | | | |
|---|---|---|---|---|---|
| | 2007 | 2008 | 2009 | 2010 | 2011 |
| 1. Syrup Multivitamin | 0.30 | 0.341 | 0.55 | 0.54 | 0.717 |
| 2. Paracetamol Supp. 125mg | 0.090 | 0.100 | 0.1142 | 1.28 | 0.98 |
| 3. Amlodipine 5mg (Tab) | 0.075 | 0.080 | 0.0888 | 0.050 | 0.130 |
| 4. Injuction Pethidins 100mg | 0.85 | 0.90 | 0.96 | 0.96 | 1.24 |
| 5. Tab. Nifidipine 20mg | 0.04 | 0.05 | 0.030 | 0.055 | 0.060 |
| 6. Syrup Flgyl (Metronidazole) | 0.39 | 0.44 | 0.500 | 0.7900 | 0.660 |
| 7. Timolol (Eye drop) 0.5% | 3.00 | 3.00 | 3.30 | 2.60 | 2.739 |
| 8. Salbutamol (syrup) 200ml | 3.70 | 4.00 | 4.20 | 4.50 | 3.00 |
| 9. Syrup Erythromycin 125mg/5ml | 0.85 | 0.90 | 1.90 | 1.00 | 1.00 |
| 10. Syrup Flucloxacillin | 0.68 | 0.70 | 1.250 | 1.10 | 1.05 |
| 11. Cap Clindaycin 150mg | 0.30 | 0.375 | 0.375 | 0.550 | 0.28 |
| 12. Tab Prednisoline 5mg | 0.02 | 0.02 | 0.0098 | 0.024 | 0.020 |
| 13. Inj. Hydrocortisine 100mg | 0.35 | 0.40 | 0.40 | 0.75 | 0.73 |
| 14. Tab Amlodipine 10mg | 0.100 | 0.110 | 0.110 | 0.088 | 0.134 |
| 15. Susp. Amoxyl (Amoxycillin) | 0.50 | 0.57 | 0.55 | 0.850 | 1.10 |
| 16. Cap Amoxyl 250mg (Amoxycillin) | 0.0200 | 0.02596 | 0.030 | 0.026 | 0.037 |
| 17. Tab Buscopan 10mg (Hyosine Butyl Bromide) | 0.025 | 0.030 | 0.030 | 0.070 | 0.0675 |
| 18. Tab Paracetamol 500mg | 0.0030 | 0.00462 | 0.0050 | 0.0062 | 0.0095 |

| | | | | | |
|---|---|---|---|---|---|
| 19. Tab Cefuroxime (zinnate) 250mg | 0.580 | 0.600 | 0.630 | 0.850 | 0.680 |
| 20. Inj. X-Pen (Benzyl Penicillin Imu) | 0.15 | 0.18 | 0.16 | 0.2 | 0.28 |
| 21. Susp. Albendazole 400mg | 0.500 | 0.850 | 0.450 | 0.700 | 0.660 |
| 22. Chlorpheneranine 4mg | 0.005 | 0.005 | 0.005 | 0.700 | 0.660 |
| 23. Calamine Ointment | 0.06 | 0.005 | 0.005 | 0.005 | 0.011 |
| 24. Magnesium Tricilicate+Aluminium Hydroxide Mix. | 1.50 | 0.70 | 0.70 | 0.80 | 0.80 |
| 25. Tab Multivite | 0.001 | 1.70 | 1.43 | 2.60 | 2.00 |
| 26. Tab Bendrofluazide 5mg | 0.015 | 0.0015 | 0.0020 | 0.0018 | 0.0092 |
| 27. Vitamin B-complex | 0.005 | 0.018 | 0.018 | 0.020 | 0.048 |
| 28. Tab Folic Acid 5mg | 0.006 | 0.006 | 0.0018 | 0.0018 | 0.0035 |
| 29. Tab Brufen 200mg (Ibuprofen) | 0.010 | 0.010 | 0.015 | 0.015 | 0.0099 |
| 30. Cotrimoxazole 480mg | 0.016 | 0.0170 | 0.0170 | 0.0176 | 0.0176 |
| 31. Ascobin Acid | 0.005 | 0.006 | 0.0039 | 0.0050 | 0.0065 |
| 32. Cap. Tramadol 50mg | 0.120 | 0.138 | 0.100 | 0.130 | 0.235 |
| 33. Azithromycin 250mg | 0.80 | 0.84 | 0.48 | 0.48 | 0.54 |
| 34. Tab citrizine (Immunex) 10mg Dihydrochloride | 0.060 | 0.070 | 0.050 | 0.050 | 0.060 |
| 35. Susp. Haematonics (Iron III) | 1.500 | 1.850 | 1.250 | 2.00 | 1.80 |
| 36. Inj. Diclofenac 75mg | 0.15 | 0.18 | 0.28 | 0.25 | 0.1342 |
| 37. Simple Linctus | 1.00 | 1.20 | 0.80 | 0.75 | 1.00 |
| 38. Syrup Liquid Parafin | 1.600 | 1.800 | 1.1300 | 1.5990 | 2.200 |

| | | | | | |
|---|---|---|---|---|---|
| 39. Diclofenac Gel 30g | 0.870 | 0.900 | 0.950 | 1.800 | 0.896 |
| 40. Tab Metformin 500mg | 0.02 | 0.02 | 0.028 | 0.045 | 0.030 |
| 41. Flucloxacillin Capsules 250mg | 0.0400 | 0.0418 | 0.0424 | 0.0800 | 0.0605 |
| 42. Oral Rehydration Salt | 0.08 | 0.08 | 0.112 | 0.20 | 0.2 |
| 43. Lidocaine 2% | 0.800 | 0.890 | 0.890 | 2.00 | 2.50 |
| 44. Amoxicillin + Clavulanic Acid | 0.50 | 0.53 | 0.68 | 0.60 | 0.644 |
| 45. Decatylene Lozenges | 0.1500 | 0.1800 | 0.1975 | 0.300 | 0.300 |
| 46. Povidone Iodine Solution | 1.20 | 1.40 | 1.80 | 2.00 | 2.20 |
| 47. Loperamide 2mg | 0.050 | 0.050 | 0.055 | 0.055 | 0.715 |
| 48. Frusemide 40mg | 0.0080 | 0.0094 | 0.022 | 0.022 | 0.25 |
| 49. Iron III (Cap Haematonics) | 0.85 | 1.90 | 0.042 | 0.09 | 0.09 |
| 50. Tab Lisinopril 10mg | 0.130 | 0.130 | 0.135 | 0.140 | 0.170 |

**Appendix V**

## Inventory Holding Cost

| YEAR | HOLDING COST (GH¢) |
|---|---|
| 2007 | 500.00 |
| 2008 | 650.00 |
| 2009 | 800.00 |
| 2010 | 820.00 |
| 2011 | 870.00 |
| **Total** | 3640.00 |



. Average Holding Cost = GH¢ $\frac{3640}{5}$

= GH¢ 728.00