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Total quality management, supplier quality and operational efficiency in the public health sector in the Upper East Region of Ghana

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Abstract
The purpose of this study was to examine the role that Total Quality Management (TQM) plays in ensuring operational efficiency via supplier quality in public health sector in the Upper East Region. Specifically, the study examined the effect of TQM on supplier quality; effect of TQM on operational efficiency; effect of supplier quality on operational efficiency and finally assessed the mediating role that supplier quality plays in the relationship between TQM and operational efficiency within these health sectors in the Upper East region. Structured questionnaire was utilized to solicit primary data from the study's respondents. The selection of 174 sampled respondents from the total population of 352 public health facilities were done using a simple random sampling procedure. Also, version 24 of the IBM SPSS software and the SmartPLS model was utilised to process the data. The demographic characteristics of the respondents were analysed with the help of descriptive tools such as means and standard deviation, while PLS-SEM was employed in testing the cause-and-effect hypothesised relationships between the variables. The findings revealed that total quality management had a positive significant effect on supplier quality. Likewise, the objective two showed that total quality management had a positive statistically significant effect on operational efficiency. The third objective showed that supplier quality had a positive statistically significant effect on operational efficiency, and the fourth research objectives revealed a positive statistically significant mediating effect of supplier quality in the relationship between total quality management and operational efficiency. The study recommended that, management of health facilities within the Upper East region should emphasize on putting measures in place to ensure the improvement of their TQM practices to help set standard that will ensure that suppliers' goods and services conform to quality standards.

Introduction
The health sector plays a crucial role in society, as it is responsible for promoting and maintaining the physical, mental, and social well-being of individuals and communities. The health sector includes a wide range of professionals, institutions, and organizations, such as hospitals, clinics, public health agencies, and medical research facilities. The relevance of the health sector can be seen in its impact on individuals, communities, and the economy. One of the primary benefits of a strong health sector is improved health outcomes for individuals. This includes reducing mortality rates, increasing life expectancy and improving the quality of life for people with chronic conditions.

A strong health sector also contributes to the overall well-being of communities by preventing the spread of infectious diseases and reducing the burden of illness on individuals and society. This, in turn, can lead to improved productivity and economic growth (WHO, 2013). The health sector furthermore plays a critical role in addressing global health challenges, such as the COVID-19 pandemic, emerging infectious diseases, and the growing burden of non-communicable diseases (WHO, 2020). The health sector's ability to respond effectively to these challenges is essential for maintaining global health security and promoting equitable access to healthcare. Despite its importance, the health sector faces significant challenges, such as rising healthcare costs, an aging population, and a shortage of healthcare professionals. These challenges require innovative solutions, such as digital health technologies, expanded training and education programs, and improved healthcare financing mechanisms (Institute of Medicine, 2013).

Other major significant challenges faced by the public health sector is ensuring the quality of supplies and equipment used in healthcare services (WHO, 2017). The quality of supplies and equipment used in healthcare services is crucial as it directly impacts patient outcomes. Supplier quality is the degree to which a supplier's goods or services meet or exceed the expectations of the buyer (Sohal & Fitzpatrick, 2002) Bottom of Form. In the public health sector, suppliers may provide a range of products and services, including medical equipment, pharmaceuticals, and healthcare services. Poor quality supplies and equipment can lead to medical errors, infections, and other adverse events, which can have severe consequences for patient health and safety. Ensuring the quality of supplies and equipment used in healthcare services is, therefore, a critical issue for the public health sector. Another challenge faced by the public health sector is achieving operational efficiency (Liu et al., 2020). Operational efficiency is the ability of an organization to maximize productivity and minimise waste. In the public health sector, operational efficiency can be improved by reducing wait times, improving patient flow, and optimizing resource utilization. It can also lead to better patient outcomes, improved staff satisfaction, and reduced healthcare costs. Operational efficiency is essential in the public health sector to ensure that healthcare services are delivered effectively and efficiently. Operational inefficiencies can lead to long wait times, delayed appointments, and other issues that can impact patient care and satisfaction (Jha, Orav & Epstein, 2009). Achieving operational efficiency is, therefore, critical for the public health sector. In the public health sector, ensuring supplier quality and operational efficiency according to Al-Qatawneh, Al-Habashneh and Al-Qatawneh (2019) is crucial to providing high-quality healthcare services to patients.

The quality of healthcare services depends heavily on the quality of the products and services provided by suppliers, such as medical devices, drugs, and laboratory services. Furthermore, operational efficiency plays a critical role in ensuring that healthcare facilities can provide timely and cost-effective services to patients. Total quality management (TQM) has emerged as a popular approach to improving supplier quality and operational efficiency in the public health sector. Total Quality Management (TQM) according to Sivakumar et al. (2019) is an approach that can help the public health sector improve supplier quality and operational efficiency. TQM according to Aigbavboa, Thwala and Alexander (2018) can be used to improve supplier quality by involving suppliers in the quality improvement process. This can include establishing quality standards for suppliers, providing feedback to suppliers on the quality of their goods or services, and working with suppliers to identify and address quality issues. By improving supplier quality, TQM can help to ensure that patients receive high-quality care and reduce the risk of adverse events. TQM can also be used to improve operational efficiency in the public health sector. This can involve identifying and eliminating waste in processes, improving communication between staff, and involving staff in the process of continuous improvement. By improving operational efficiency, TQM can help to reduce costs, improve patient flow, and increase staff satisfaction (Zeng, Tam & Tam, 2007).

The health sector is a critical component of society, and its relevance is evident in its impact on individuals, communities, and the economy. Efforts to strengthen the health sector must be prioritized to address existing challenges and respond to emerging health threats. Improving supplier quality and operational efficiency is critical to achieving better health outcomes and reducing healthcare costs in the public health sector. TQM provides a useful framework for achieving these goals by including every worker in the process of ongoing improvement. A management concept known as TQM places a strong emphasis on ongoing development, client happiness, and employee empowerment. Its principles can be applied to all aspects of healthcare operations, from supplier selection to service delivery, to improve quality and efficiency. Effective implementation of TQM in the public health sector requires a culture of continuous improvement and commitment from all stakeholders, including healthcare providers, suppliers, and regulatory bodies. Based on the above, it can be deduced that by adopting TQM principles, healthcare facilities can improve supplier quality, reduce costs, and increase operational efficiency, likewise when

suppliers' quality is improved it would lead to a better operational efficiency, resulting in better patient outcomes and a more sustainable healthcare system. On this note, a study was carried out to look at TQM orientation of the public health sector and how it is affecting the supplier quality and its subsequent contribution to operational effectiveness.

The health sector notwithstanding the critical role it plays, faces problems of low-quality products, dissatisfied customers and supplier issues (Southwell, Wood & Navar, 2020; Mao et al., 2022). The health sector in the Upper East Region is under-resourced, which limits healthcare practitioners' capacity to offer excellent treatment (Ghana Health Service, 2016). A World Health Organisation (WHO) investigation discovered that up to 30% of medications supplied in Ghana, including the Upper East region, are counterfeit or substandard (WHO, 2017). This problem can jeopardise therapy efficacy and endanger patients' health. Furthermore, research conducted by the Ghana Health Service (2018) revealed that suppliers of medical equipment and supplies in some regions including the upper east region have no proper quality control mechanisms in place. Medical supplies and equipment must be properly stored and transported to retain their quality and usefulness. However, there is a lack of appropriate storage and transportation facilities in several regions of Ghana, especially the Upper East Region, which has resulted in the deterioration of medical supplies (Ghana Health Service, 2018; Tawiah, Adongo & Ali, 2014). Total Quality Management (TQM) is a strategy that is now used in many businesses to improve operational performance and address the difficulties in the public health sector (Charantimath, 2017).

Despite the widespread adoption of total quality management (TQM) principles in the public health sector, there is limited empirical evidence on its impact in supplier quality and operational efficiency within the public health sector in the Upper East region of Ghana. For instance, Zaidi and Ahmad's (2020) study focused on Malaysia's industrial sector; Kebede, Adem and Virdi (2021) focused on Ethiopian manufacturing companies, while Anafo and Appiah-Nimo (2018) concentrated on Ghana Airport Company Ltd. These studies provide a contextual gap because they concentrated on areas other than the health sector, hence adopting their recommendations within the scope of the latter would be misleading. It was, therefore, justifiable to investigate the relationship between the implementation of TQM, supplier quality and operational efficiency within the context of health institutions in Upper East region, Ghana. Based on these contextual gaps, this research aims to explore the interplay between supplier quality, TQM, and operational efficiency in the public health sector in the Upper East region, with the goal of identifying strategies that can be used to improve the quality and efficiency of healthcare delivery. Based on this gap, the study seeks to examine the role that TQM of healthcare firms plays in ensuring operational efficiency via supplier quality.

Literature Review

Theoretical Review

There are diverse theories on TQM, each recognizing philosophy and concept about it. This research is largely concerned with TQM theories that recognise its connection with supplier quality and operational efficiency. The study therefore employed the Deming's Theory of Total Quality Management as the overreaching theory underpinning the work. This theory places an emphasis on enhancing procedures and goods over time to satisfy the requirements and expectations of customers. The theory was developed by Edwards Deming, an American statistician, who believed that quality is a key factor in achieving business success. The theory of TQM is based on four main principles: customer focus, continuous improvement, employee involvement, and process management. The first principle, customer focus, requires companies to understand the needs and expectations of their customers and to design processes and products that meet those needs. Continuous improvement involves continually improving processes and products to increase efficiency, reduce waste, and improve quality. Employee involvement requires companies to empower their employees to contribute to the improvement of processes and products. Process management involves managing processes to ensure that they are efficient, effective, and meet customer requirements. One critical aspect of TQM is supplier quality. Deming emphasized the importance of selecting and working with high-quality suppliers to ensure that the materials and components used in the production process meet the necessary quality standards. According to Deming, supplier quality is a critical factor in achieving operational efficiency and improving product quality.

Operational efficiency is another essential component of TQM (Zaidi & Ahmad, 2020).

The theory encourages companies to focus on improving operational efficiency by reducing waste, improving processes, and increasing productivity. By continuously improving operational efficiency, companies can achieve cost savings, increase profitability, and improve customer satisfaction. The theory

therefore emphasizes the importance of quality in achieving business success. The theory focuses on continuous improvement, employee involvement, process management, and customer focus. Supplier quality and operational efficiency are critical components of TQM, and health care providers must work to ensure that they are selecting high-quality suppliers and continuously improve their processes to achieve optimal efficiency and quality.

Empirical Review

Total Quality Management and Supplier Quality

TQM is a management concept that emphasises the significance of continual improvement in all facets of an organization's operations. One of the critical components of TQM is supplier quality management. The quality of the products or services delivered by suppliers can have a significant impact on the quality of the final product or service provided by the organization. TQM has been widely used in the private sector, and there is increasing interest in applying its principles to the public health sector. Numerous empirical studies have been conducted to investigate the effect of TQM on supplier quality in the healthcare and other organizations. For example, a study by Permana, Purba and Rizkiyah (2021) found that TQM practices such as supplier evaluation and selection, supplier development, and continuous improvement were positively associated with supplier quality in the healthcare industry. Also, a study conducted by Lin et al. (2013) found that the adoption of TQM practices by an organization positively impacted supplier quality. The study used a survey of 207 Taiwanese manufacturing firms to gather data and found that organizations that implemented TQM practices had higher supplier quality than those that did not. Another study by Saragih, Tarigan, Pratama, Wardati and Silalahi (2020) investigated the impact of TQM practices on supplier quality in the automotive industry. The study used data from the National Quality Research Center's database and found that organizations that implemented TQM practices had better supplier quality than those that did not. A study by Samson and Terziovski (1999) also investigated the impact of TQM practices on supplier quality. The study used a survey of 209 Australian manufacturing firms and found that organizations that implemented TQM practices had better supplier quality than those that did not.

A study by Prajogo and Sohal (2001) investigated the relationship between TQM practices and supplier quality in the Australian automotive industry. The study used a survey of 78 organizations and found that TQM practices positively impacted supplier quality. Another study by Prajogo and Sohal (2003) investigated the impact of TQM practices on supplier quality in the Australian food industry. The study used a survey of 68 organizations and found that organizations that implemented TQM practices had better supplier quality than those that did not. This empirical evidence suggests that the adoption of TQM practices positively impacts supplier quality. The studies reviewed consistently show that organizations that implement TQM practices have better supplier quality than those that do not. Therefore, it is recommended that organizations that are interested in improving their supplier quality should consider implementing TQM practices. Based on this the study hypothesises that:

H_1: Total quality management practice has a significant effect on supplier quality

Total Quality Management on Operational Efficiency

A study by Chowdhury and Paul (2012) found that the implementation of TQM practices such as process improvement and employee involvement was associated with improved operational efficiency in public hospitals in Bangladesh. The authors argued that the adoption of TQM practices could help to overcome some of the challenges facing public healthcare systems in developing countries, such as resource constraints and a lack of trained personnel. In their 2022 study, Acquah, Quaicoe, and Arhin examined how TQM practices affect operational performance and how they interact to affect the operational performance of healthcare institutions. Using a sample of 154 health facilities (pharmacies, private hospitals, maternity clinics, and diagnostic centres), the authors evaluated how TQM practises impact the operational performance of health facilities in Ghana's Ashanti Region. They used symmetric (PLS-SEM) and asymmetric (fsQCA) data analysis approaches. Five out of the seven TQM practices examined had an impact on operational efficiency, according to the PLS-SEM findings. The findings of the fsQCA, however, reveal five various sophisticated combos of TQM techniques that influence operational performance.

The mitigating impact of the external environment on the links between total quality management, business orientation, market orientation, and success of small and medium companies was studied by Asad, Chethiyar, and Ali (2020). Data was gathered using a self-administered form from small and medium-sized businesses working in Sialkot, Pakistan. The results demonstrated that market orientation, entrepreneurial

orientation, and overall quality management were all highly important predictors of success for small and medium-sized businesses. Additionally, it was determined that there was a substantial moderating influence of the exterior environment on the relationships between overall quality management, entrepreneurial orientation, market orientation, and success. Zaidi and Ahmad (2020) looked into the connection between TQM methods and operational effectiveness in Malaysia's manufacturing sector. Organizational leadership, client happiness and partnerships, human resources emphasis, strategy planning and development, and supplier quality management were all examined as TQM practice aspects. This study used a scientific approach to its investigation. The results demonstrated that TQM standards and organizational effectiveness are at a high level. Furthermore, the findings showed that operational success and each of the five TQM practice aspects were significantly and favourably correlated. In order to ensure that overall efficiency improves in manufacturing businesses, it was recommended that the adoption of TQM techniques is crucial. Based on the above, the study hypothesises that:

H_2: Total quality management practice has a significant effect on operational efficiency

Supplier Quality on Operational Efficiency

Research studies have shown that supplier quality can have a significant impact on the operational efficiency of an organization. A study by Hassan and Jaaron (2021) examined the effect of supplier quality on operational efficiency in the context of Chinese manufacturing firms. The study found that supplier quality had a positive and significant impact on operational efficiency, as measured by production capacity utilization, delivery performance, and defect rate. Another study by Lamine and Lakhal (2018) investigated the relationship between supplier quality and operational performance in the South Korean automotive industry. The study found that supplier quality had a significant positive effect on operational performance, as measured by on-time delivery, defect rate, and inventory turnover. The effect of supplier quality management (SQM) on the quality performance of industrial firms working in the Pearl River Delta (PRD) region of Southern China was evaluated by Lo, Sculli, and Yeung in 2006. A model that illustrates how SQM enhances quality performance and the beneficial impact of supplier quality on corporate quality performance was developed using path analysis. 138 industrial and factory-related businesses in the PRD provided information. The path model shows that SQM practices have a big impact on quality performance and also shows how supplier quality has a positive impact on the organization's total quality performance. Results show that TQM principles can be a crucial motivator for SQM adoption.

In a study by Orji and Ojadi (2021), the authors examined the impact of supplier quality on operational performance in the Nigerian manufacturing industry. The study found that supplier quality had a positive and significant impact on operational performance, as measured by productivity, delivery performance, and defect rate. A study by Njuguna et al. (2020) investigated the effect of supplier quality on operational performance in the Kenyan manufacturing industry. The study found that supplier quality had a positive and significant effect on operational performance, as measured by delivery performance, production lead time, and defect rate. Finally, a study by Sadeghi et al. (2021) examined the effect of supplier quality on operational performance in the Iranian automotive industry. The study found that supplier quality had a positive and significant impact on operational performance, as measured by on-time delivery, defect rate, and customer satisfaction. Overall, these studies suggest that supplier quality can have a positive and significant impact on operational efficiency, as measured by various performance indicators such as delivery performance, defect rate, productivity, and customer satisfaction. This underscores the importance of maintaining high levels of supplier quality in order to improve operational efficiency and competitiveness in today's global market. The study therefore hypothesis that:

H_3: Supplier quality has a significant effect on operational efficiency

Total Quality Management, Supplier quality and Operational Efficiency

One of the key components of TQM is supplier quality management, which involves managing the quality of inputs from suppliers to ensure the quality of the final product or service. Operational efficiency, on the other hand, refers to the ability of an organization to produce goods or services at a minimum cost while maintaining quality. Research indicates that TQM help firms achieve supplier quality which in turns help achieve operational efficiency. Several studies have examined the relationship between TQM and operational efficiency, and the mediating role of supplier quality in this relationship. Baraei and Mirzaei (2019) conducted a study in the Iranian automotive industry and found that supplier quality partially mediates the relationship between TQM and operational efficiency. Basheer, Hafeez, Hassan and Haroon (2018) conducted a study in the Pakistani textile industry and found that supplier quality fully mediates the

relationship between TQM and operational efficiency. Karim and Rabiul (2022) conducted a study in the Bangladeshi apparel industry and found that supplier quality partially mediates the relationship between TQM and operational efficiency. Parmar and Desai (2020) conducted a study in the Iranian food industry and found that supplier quality partially mediates the relationship between TQM and operational efficiency. Farooq, Yusop and Chaudhry (2019) conducted a study in the Pakistani automotive industry and found that supplier quality partially mediates the relationship between TQM and operational efficiency. Overall, these studies suggest that supplier quality plays a significant mediating role in the relationship between TQM and operational efficiency. Improving supplier quality can lead to improved operational efficiency, and TQM can facilitate this process. The study therefore hypothesises that:

H_4: Supplier quality plays a significant moderating role in the relationship between total quality management practice and operational efficiency

Conceptual Model

From the literature reviewed, we developed a research model to demonstrate the relationship between the variables under study (Total quality management, Supplier Quality and Operational Efficiency). The framework is depicted in Figure I below.

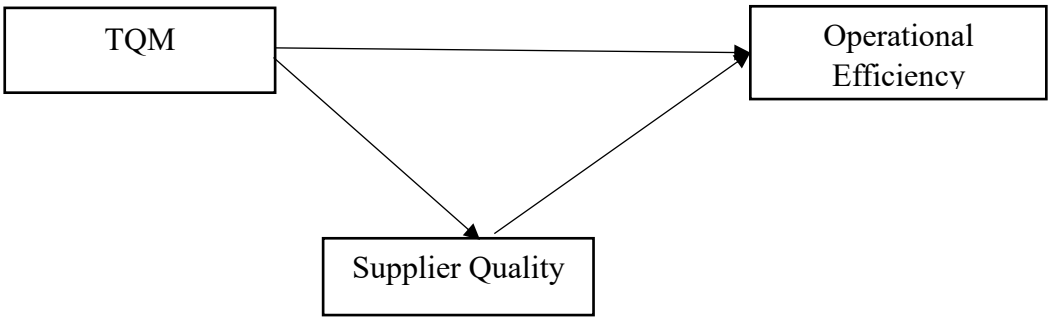

Figure 1: Conceptual Framework
Source: Authors own construct

Methods

To meet the research objectives, the study used a survey questionnaire and four hypotheses. The study adopted the positivist philosophy thus relying solely on the quantitative method using the explanatory research design. Structured questionnaire was developed from data gathered from previous studies on TQM. The simple random sampling technique was utilised to select a sampled respondent of one hundred and eighty-two (182). Out of this, one hundred and seventy-four (174) valid responses were used for the data processing. Using IBM SPSS Statistics (version 24) and SmartPLS (version 3) tools, the data was then processed. Both descriptive as well as inferential statistics were utilized. The socio-demographic data of the respondents was analysed using frequencies and percentages. Hypothesis testing was carried out using the partial least squares structural equation modelling method. The significance test was based on the premise that the t-statistics should be greater than 1.96, with a p-value of less than 0.05. The key results of the analysis concerning the research objectives were finally discussed in this section.

Data Analysis and Discussion

Demographic Characteristics of Respondents

Frequency and percentages (%) were used to measure the respondents' demographic data in a descriptive manner since they are suitable statistical techniques for measuring categorical data. The survey respondents are sufficiently described by this information to demonstrate that the sample was drawn from the intended audience. The results were displayed in Table 1.

Table 1: Demographic Information of Respondents

Variable	Category	Frequency	Percent
Gender	Male	83	47.7
	Female	91	52.3
		174	100.0
Total			
Age	18-30	45	25.9
	31-40	79	45.4
	41-50	32	18.4
	>50	18	10.3
Total		174	100.0
Level of Education	Certificate	15	8.6
	Diploma	56	32.2
	Bachelor	85	48.9
	Postgraduate	18	10.3
Total		150	100.0
Health facility	Hospital	45	25.9
	Clinic	83	47.7
	CHPS	33	19.0
	Others	13	7.5
Total		174	100.0

Source: Field Survey (2023)

According to Table 1, the number of men who answered the questionnaire were 83, representing 47.7% of the participants, while the number of females who responded to the questionnaire were 91, representing 52.3% of the participants. The data on the sex demographic features of the respondents suggest that the majority of the respondents were females. Secondly, of the entire sample population that responded to the surveys, 45 of them were between the ages of 18 and 30, accounting for 25.9%, and 79 were between the ages of 31 to 40, accounting for 45.4 percent, 32 of them were between the ages of 41-50 representing 18.4% and 18 of them were over 50 and above years of age representing 10.3%. The findings on the age demographic characteristics of the respondents, majority of them were between the ages of 31 and 40 years old, as seen in the table 2.

Furthermore, of the overall sample population that responded to the surveys, it was revealed that 15 of them representing 8.6% had certificate as their qualification, 56 of them representing 32.2% had a diploma certificate. 85 of them representing 48.9% had a bachelor's degree and the remaining 18 of them representing 10.3% had a postgraduate degree. The findings on the respondent's programme showed that majority of have obtained their first degree. It also shows that the respondents were knowledgeable enough in answering the questions.

Finally, the specific health sector that the respondents worked was also assessed. It was revealed that 45 representing 25.9 % of them were working in hospitals, 83 of them representing 47.7% were working in clinics, 33 of them representing 19.0% were working in CHPS compound whereas the remaining 13% were working in other public health sectors. This shows that within the upper east region, most of the public health facilities there are clinics.

Assessment of Model

The study sought to examine the role that TQM plays in ensuring operational efficiency via supplier quality. Four (4) hypotheses were developed and analysed using SEM with the aim of answering the main purpose of the research. Prior to the actual hypotheses testing, the qualities of the PLS-SEM were first assessed using item loadings, indicator reliability (IR), convergent validity (CV), construct reliability (CR), multicollinearity (i.e., inner VIF) and discriminant validity (i.e., HTMT). Hair et al. (2019) and

Henseler (2017) stressed that the model qualities are assessed and reported to make meaning out of the structural model results. They also ensure that the model meets the expected criteria and thus, its findings could be relied upon to influence policies and practices in any organisational setting.
The output of the software was a model which had one endogenous variable, one exogenous variable and one variable acting as exogenous and a mediator as well. The endogenous variable was operational efficiency which had ten (10) indicators and the exogenous variables were Total Quality Management with seven (7) indicators and supplier quality with seven (7) indicators. The diagram of the initial model is shown in Figure 2 below.

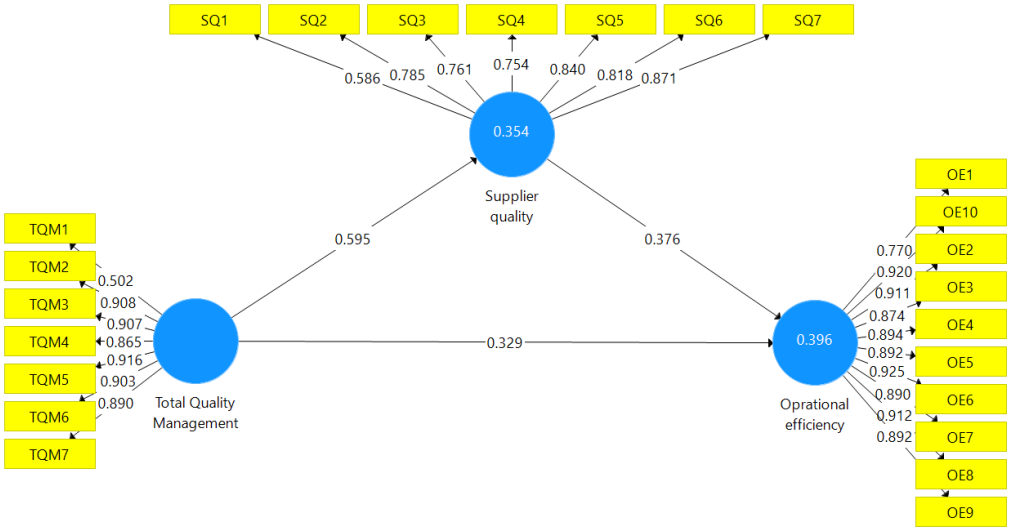

Figure 2: Model extracted from PLS Algorithm
Source: Field Survey (2023)

Figure 2 showed that the exogenous constructs had seven indicators, the endogenous construct also had ten indicators and the mediating variable also had seven indicators. More precisely, Total Quality Management (TQM) comprised TQM1, TQM2, TQM3, TQM4, TQM5, TQM6 and TQM7; Supplier Quality (SQ) comprised SQ1, SQ2, SQ3, SQ4, SQ5, SQ6 and SQ7; and finally, Operational Efficiency (OE) had loadings comprising OE1, OE2, OE3, OE4, OE5, OE6, OE7, OE8, OE9 and OE10. These constructs together with their indicators were used to draw the four paths using arrows to signify relationships between the exogenous, mediating and endogenous variables (see Figure 2).

From Figure 2, the arrows moving from the independent variables and pointed at the dependent variable show that TQM and SQ could have significant individual relationships, TQM and OE could have significant individual relationships, SQ and OE could have significant individual relationships and TQM, SQ and OE could have significant mediating relationships. Simply put, the path arrows suggested the following correlations: TQM and SQ; TQM and OE; SQ and OE; and finally, TQM, SQ and OE. This model was then assessed by evaluating the constructs' indicator values. The assessment was done to ensure that each indicator provides a quality measure of its assigned construct. The rule suggests that each indicator's loading should be > 0.70 to signify a quality measure of its construct (Hair et al., 2021; Henseler et al., 2009). Thus, item loadings of each construct < 0.70 should be removed from the model because they were assumed to be inferior measures of their assigned constructs.

Item loadings that are deleted from the model, according to Hair et al. (2019), do not provide accurate measurements of the given constructs. Because of this, leaving them in could degrade the model's output. As a result, all item loadings below 0.7 in the original model were properly eliminated, showing that not all of the items collected from prior studies were accurate measures of their given categories in the context of this research. Figure 3 presented the final model structure after all indicator loadings < 0.60 were removed as suggested by Hair et al. (2017) and Henseler et al. (2009).

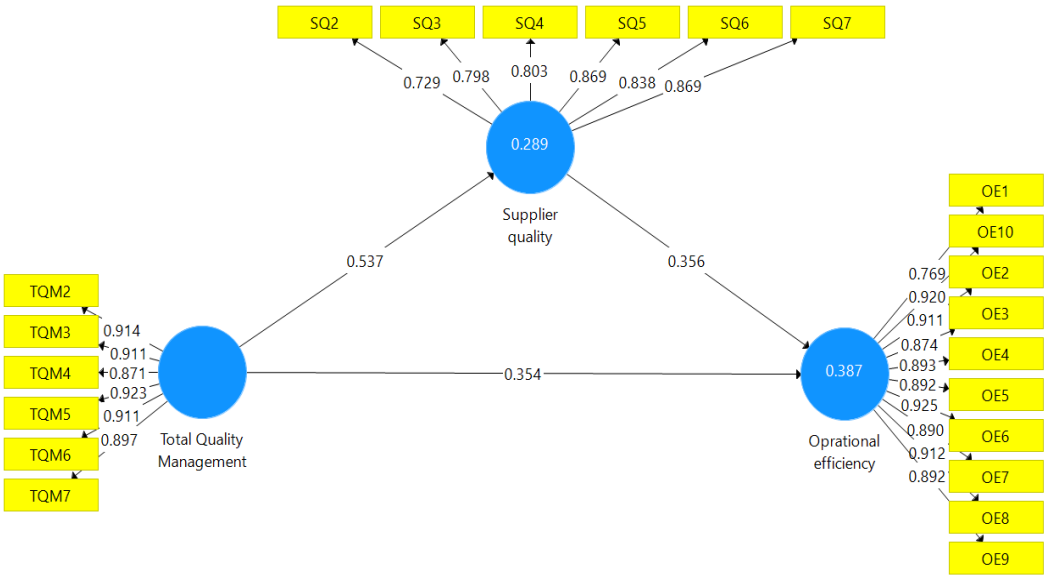

Figure 3: Final Model Structure extracted from PLS Algorithm
Source: Source: Field Survey (2023)

Figure 3 showed that all the indicators for the constructs had item loadings > 0.70 and that all the indicators below the recommended level were eliminated. This was done to make sure that all of the construct indicators were reliable and accurate metrics for this research. More specifically, in terms TQM, TQM1 was removed; for SQ, SQ1 was also removed, however, all the indicators for OE meet the criteria by Hair et al. (2019). This implies that all the ensuing assessments and analysis were based on the final model structure in Figure 3.

Assessment of Measurement Model

Table 2 presented the quality assessment of the measurement model using composite reliability (CR) and convergent validity (CV) using the average variance extracted (AVE) scores. Also, discriminant validity and multicollinearity based on inner VIF values were all assessed and discussed in this section.

Table 2: Assessment of Measurement Model

	CR	(AVE)	VIF Values
Operational efficiency	0.974	0.790	
Supplier quality	0.924	0.670	1.406
Total Quality Management	0.964	0.819	1.406

CR – Composite reliability; AVE – Convergent validity; VIF- Multicollinearity
Source: Field Survey (2023)

In determining the internal reliability of the model, the composite reliability of Jöreskog (1971) is most frequently favoured. This is because, Composite reliability, unlike Cronbach's Alpha, does not require that all indicator loadings in the population are equal., which is consistent with the PLS-SEM algorithm's working principle of prioritizing indicators during model estimate depending on their reliability. In exploratory research, values of 0.60 to 0.70 are considered satisfactory, whereas values of 0.70 to 0.90 are deemed satisfactory in more advanced stages of research using composite reliability (Nunnally, 1994). From Table 2, composite reliability for the outer model ranged from 0.924 – 0.974, indicating that the structures' internal consistency was ensured.

The accuracy of the exterior model has also been assessed. A structure's parallel and selective validity was evaluated for validity. The extent to which a concept converges to characterize the variation of its products is known as convergent validity (Hair et al., 2019). Convergent validity is supported because each structure's average variance extracted (AVE) is 0.670 or greater. According to Hair et al. (2014), the

AVE is the main average value of square loading of a group of indicators and is similar to the communality of a construct. Simply put, an AVE of 0.50 indicates that the build accounts for more than half of the variance in the metrics. Thus, from Table 2, AVE for the various constructs was all above the 0.50 threshold, hence convergent validity was ensured.

The inner VIF scores were also given in Table 2 in order to explicitly aid in checking for potential multicollinearity. Additionally, it aids in minimizing prevalent technique bias in the research. According to Hair et al., (2021), multicollinearity is evaluated to determine whether the route parameters are bias-free. Additionally, it makes sure that any major areas of potential collinearity between the exogenous factors are greatly reduced. To verify for multicollinearity, all inner VIF numbers must be less than 10 (Pallant & Manuel, 2007). Pallant (2020) claim that multicollinearity appears when the VIF values are greater than 10, and that this could have an impact on the model's performance. All of the VIF values were well below 10, which indicated the lack of multicollinearity. More precisely, all VIF values are 1.406 indicating that no multicollinearity exists among the constructs.

The model's discriminant validity (DV), as suggested by Henseler et al. (2012) was also tested as part of the research to evaluate the model's quality. In a model, DV looks for potential collinearity problems (Hair et al., 2017). According to Hair et al. (2017), DVs with substantial amounts of discriminant validity typically don't have collinearity. Three main methods for examining DV in a PLS-SEM model have been presented in earlier research (Fornell & Larcker, 1981; Hair et al., 2019; Henseler et al., 2012). These approaches included Fornell and Larcker (1981), cross loadings and Heterotrait-Monotrait (HTMT) ratio. However, this study employed the HTMT approach and this is showed in Table 3 below.

Table 3: Heterotrait-Monotrait Ratio (HTMT)

	Operational efficiency	Supplier quality
Supplier quality	0.581	
Total Quality Management	0.565	0.574

Source: Field Survey (2023)

Voorhees et al. (2016) proposed a heterotrait-monotrait (HTMT) relationship. HTMT is when item correlations' average value across constructs in respect to the geometric average correlations of objects measuring the same construct. More precisely, HTMT has the strength of easily detecting absence of DV in basic research unlike the others. Values for the construct's HTMT is displayed in table 3 above. The rule of thumb for assessing HTMT is that the correlation values between the constructs should be < 0.90 (Wetzels, Odekerken-Schroder & Vab Oppen, 2009). Simply put, discriminant validity is achieved if the HTMT scores are < 0.90. It could, therefore, be deduced from Table 3 that all the HTMT values for the constructs are < 0.90 with the highest value of 0.581 in the relationship between SQ and OE. This result suggests that the constructs are clearly different from each other.

Explanation of Target Endogenous Variable Variance

The coefficient of determination (R^2) score was used in this part to indicate how accurately the model predicted future events. Other significant estimates were also given, including "predictive relevance (Q2) based on the Stone-Giesser test and effect size (f2) (Hair et al., 2019). The output of these elements was displayed in Table 4 and discussed. These elements were assessed to determine whether the constructs are quality measures of the model and as such, the model's output could be relied upon to draw factual conclusions.

Table 4: Explanation of Target Endogenous Variable Variance

L.V	R Square	R Square Adjusted	F^2	Q^2
Operational efficiency	0.387	0.380		
Supplier quality	0.289	0.285	0.147	0.187
TQM			0.145	0.302

"Note: L.V. = latent variable, R^2 = R squared, f^2 = effect size, Q^2 = predictive relevance"
Source: Field Survey (2023)

First reported was the forecast relevance score using the R^2 number. According to Hair et al. (2017), the joint contributions of the variables (TQM, SQ) to the dependent construct (OE) are represented

by the R^2. Simply put R^2 indicates the change in OE that is linearly explained by merging the two independent factors. According to Henseler et al. (2009), R^2 values <0.29, 0.29 - 0.67 and >0.67 represent weak, moderate and strong contributions of the predictor constructs to the endogenous construct. From Table 4, the R^2 value was 0.387; meaning that when the two independent variables (TQM, SQ) are combined, they linearly account for about 38.7 percent of change in the operational efficiency (OE).Thus TQM, SQ moderately contribute to any change in OE.

Table 4 also reported the effect size (f^2) of each independent construct by adopting Cohen's (1988) impact criterion. Cohen (1988) suggested that values of 0.02 signify small, 0.15 signify medium and 0.35 indicates large effect size (f^2) respectively. From the table, TQM had the lowest f^2 value of 0.145; followed by SQ with 0.147. These results suggest that when the two independent variables (TQM and SQ) are individually implemented, SQ would have the largest effect on the operational efficiency of health sectors in the upper east region followed by TQM respectively.

The model's forecast applicability was finally reported based on the Stone-Geisser (Q^2) test (Hair et al., 2014). In order to analyze Q^2, a section of the data matrix is removed, the model is examined, and the removed component is then predicted using the estimates (Roldán & Sanchez-Franco, 2012). Henseler et al. (2009) proposed that, $0.02 \leq Q^2 < 0.15$ shows weak effect, $0.15 \leq Q^2 < 0.35$ indicates moderate effect and $Q^2 > 0.35$ signifies strong effect. It could be deduced that all the Q^2 values were > 0 indicating that the predictors can relevantly predict the endogenous variable in the model. However, TQM had the highest Q^2 of 0.302 followed by SQ (0.187). This means that although TQM has a small effect size, it is a better predictor of operational efficiency when compared with SQ which had the largest effect size.

Significance of Path Coefficients

The research evaluated the hypotheses to determine whether significant impacts exist among the relationships after evaluating the PLS-SEM for quality reasons. This was accomplished by using 5000 bootstraps to analyse the data, as suggested by Hair et al. (2017). Table 5 presented the results with five columns representing structural paths, path coefficients (β), t-stats, p-values and decision rule of each hypothesis.

Table 5: Significance of Path Coefficients

	(β)	T Statistics (|O/STDEV|)	P Values	Decision Rule
SQ -> OE	0.356	4.185	0.000	Supported
TQM-> OE	0.354	3.985	0.000	Supported
TQM -> SQ	0.537	7.384	0.000	Supported
Indirect Effect				
TQM -> SQ-> OE	0.191	3.324	0.001	Supported (Partial)

Note: * = t > 1.96; p < 0.05

Source: Field Survey (2023)

By giving the t-stats values as advised by Hair et al. (2021), Ringle et al. (2012), and Roldán et al., this research examined the hypotheses (2012). According to the rule, in order to demonstrate that the suggested association is significant, the t-stat should be > 1.96 (i.e., p0.05) (Hair et al., 2014; Henseler et al., 2014). Simply put, a t-stat > 1.96 is synonymous with p value < 0.05; thus, both directional and indirect hypothesis (as shown in table 5) is supported. The hypotheses outcomes were reported and discussed in the following sections.

Total Quality Management and Supplier Quality

The study's hypothesis one (H_1) was that Total quality Management (TQM) had a significant effect on Supplier Quality (SQ). Given a t-stat value of 7.384>1.96, (p=0.000<0.05) the study's hypothesis was supported. This result means that a significant relationship exists between TQM and SQ; thus, TQM can directly predict any change in SQ. Table 5 also reported a β value of 0.537 to indicate that the link between TQM and SQ is positive. This also implies that any unit change in TQM would lead to a significant positive unit change in SQ by 53.7 percent. Also, per the β value, TQM has a strong effect on SQ. Thus, public health sectors within the Upper East region would be able to improve on their supplier quality towards the firm by 53.7 percent if they implement appropriate total quality management practice. The results are in line with a study by Permana et al. (2021) who found that TQM practices such as supplier evaluation and

selection, supplier development, and continuous improvement were positively associated with supplier quality in the healthcare industry. Also, Lin et al. (2013) found that the adoption of TQM practices by an organization positively impacted supplier quality.

Total Quality Management and Operational Efficiency

The significant effect of Total Quality Management (TQM) on Operational Efficiency (OE) was also tested and a t-stat of 3.985 (i.e., >1.96) and ($p=0.000<0.05$) was obtained, indicating support for the hypothesis. This result means that a statistically significant linkage exists between TQM and OE of the health care sector in the Upper East region. Table 5 also revealed a β value of 0.354 indicating a positive relationship. It also indicates that TQM significantly contributes about 35.4 percent of any change in OE. The result also suggests a medium significant effect of TQM on OE. This implies that health sector would be able to improve on their operational efficiency towards the firm by 33.9 percent if they ensure that their services conform to customer expectations. The findings are in line with a study by Chowdhury and Paul (2012) who found that the implementation of TQM practices such as process improvement and employee involvement was associated with improved operational efficiency in public hospitals in Bangladesh. Also, Zaidi and Ahmad (2020) demonstrated that TQM standards and organizational effectiveness are at a high level. Furthermore, the findings showed that operational success and each of the five TQM practice aspects were significantly and favourably correlated.

Supplier Quality and Operational Efficiency

The third research hypothesis was also tested and its output was reported in Table 5. The hypothesis was that Supplier Quality (SQ) which was also the mediating variable has a significant effect on Operational Efficiency (OE). The t-stat was 4.185 ($p=0.000<0.05$) with β of 0.356. These results mean that the hypothesis was supported; thus, SQ has a significant positive effect on OE. This implies that any unit change in SQ is likely to cause a significant unit change in OE by 35.6 percent. This outcome suggests that the effect of SQ on OE was significant, positive and moderate. Simply put that if health sector within the Upper East region is able to implement an effective TQM, they are likely to influence the operational efficiency of their activities. This result is in line with studies such as Hassan and Jaaron (2021) who examined the effect of supplier quality on operational efficiency in the context of Chinese manufacturing firms. The study found that supplier quality had a positive and significant impact on operational efficiency, as measured by production capacity utilization, delivery performance, and defect rate. Another study by Choi and Hong (2018) investigated the relationship between supplier quality and operational performance in the South Korean automotive industry. They study found that supplier quality had a significant positive effect on operational performance, as measured by on-time delivery, defect rate, and inventory turnover.

Mediating role of Supplier Quality in the relationship between Total Quality Management and Operational Efficiency

The final hypothesis was also tested to determine the mediating effect of customer loyalty in the relationship Total Quality Management (TQM) and Operational Efficiency (OE). It was hypothesised that supplier quality mediates the relationship between total quality management and operational efficiency. Table 5 revealed a t-stat of 3.324 ($p=0.001<0.05$) therefore supporting the hypothesis. It implies that supplier quality mediates the relationship between total quality management and operational efficiency, however, the mediation is partial. This is because from Table 5 the direct effect of total quality management and operational efficiency was significant, indicating that without supplier quality, total quality management would still have an impact on operational efficiency, indicating that supplier quality mediates the relationship between TQM and OE partially. This finding is in line with studies such as Baraei and Mirzaei (2019) who conducted a study in the Iranian automotive industry and found that supplier quality partially mediates the relationship between TQM and operational efficiency. Karim and Rabiul (2022) conducted a study in the Bangladeshi apparel industry and found that supplier quality partially mediates the relationship between TQM and operational efficiency. Parmar and Desai (2020) conducted a study in the Iranian food industry and found that supplier quality partially mediates the relationship between TQM and operational efficiency.

Discussion of Findings

The study examined the relationship between Total Quality Management, Supplier Quality and Operational Efficiency among public health facilities within the Upper East Region of Ghana. We therefore hypothesised that Total Quality Management had a significant effect on operational efficiency. The result obtained from the bootstrap supported our hypothesised relationship that TQM had a positive significant effect on the operational efficiency of these health facilities. Findings from previous studies support our findings by indicating that TQM is a better determinant of firms' operational efficiencies. Studies such as Zaidi and Ahmad (2020) demonstrated that TQM standards and organizational effectiveness are at a high level. Furthermore, the findings showed that operational success and each of the five TQM practice aspects were significantly and favourably correlated. Also, the results can be further explained using the Deming's Theory of Total Quality Management which places an emphasis on the need to enhance procedures and goods over time to satisfy the requirements and expectations of customers. The practical implication of these results is that TQM are key indicators in ensuring operational efficiency, hence health facilities in the Upper East region would achieve operational efficiency when TQM practices are implemented.

Moreover, the study further revealed a positive significant relationship between TQM and operational supplier quality. The outcome course of the PLS-SEM result supported our theoretical prediction that total quality management has a significant effect on supplier quality. This result shows that health facilities can improve on the quality of their suppliers through the implementation of TQM. Previous studies have demonstrated that TQM is a key indicator of supplier quality. For instance, a study by Permana et al. (2021) found that TQM practices such as supplier evaluation and selection, supplier development, and continuous improvement were positively associated with supplier quality in the healthcare industry. Also, Lin et al. (2013) found that the adoption of TQM practices by an organization positively impacted supplier quality.

Also, the findings revealed that supplier quality has a positive significant effect on operational efficiency. This result shows that supplier quality is a key factor in achieving operational efficiency by these health facilities within the study area. Thus, it is through supplier quality that these health facilities can achieve operational efficiency. The importance and significance of ensuring supplier quality can further be justified based on empirical, theoretical and practical evidence. Existing studies such as Hassan and Jaaron (2021) examined the effect of supplier quality on operational efficiency in the context of Chinese manufacturing firms. The study found that supplier quality had a positive and significant impact on operational efficiency, as measured by production capacity utilization, delivery performance, and defect rate. Another study by Choi and Hong (2018) found that supplier quality had a significant positive effect on operational performance, as measured by on-time delivery, defect rate, and inventory turnover.

The study further revealed that supplier quality partially mediates the relationship between total quality management and operational efficiency. These results could be justified that when health facilities implement total quality management initiatives it will help improve their suppliers' quality and subsequently enhance their operational efficiency. Previous studies have provided evidence on the mediating role of supplier quality in the relationship between total quality management and operational efficiency. For instance, Baraei and Mirzaei (2019) found that supplier quality partially mediates the relationship between TQM and operational efficiency. Karim and Rabiul (2022) found that supplier quality partially mediates the relationship between TQM and operational efficiency. Also, Parmar and Desai (2020) found that supplier quality partially mediates the relationship between TQM and operational efficiency.

Conclusion and Recommendation

The study concluded that total quality management has a positive significant effect on supplier quality. Indicating that an improvement in TQM will cause a significant change in the quality of goods and services provided by the suppliers. Likewise, TQM was found to have a positive significant effect on operational efficiency, indicating that an improvement in total quality management will cause a significant change in the operational efficiency level of the health sector. The study further concludes that supplier quality had a positive significant effect on operational efficiency. Finally, the study concludes that supplier quality partially mediates the relationship between total quality management and operational efficiency. The findings have a practical implication on how health care facilities in the Upper East region can achieve operational efficiency, hence, the study recommends that, management should emphasise on putting measures in place to ensure and improve their TQM practice to achieve operational efficiency. Moreover, the researcher suggest that further studies should focus on private health sector in other part of the country

to help generalise results to all health facilities in the country and contribute to existing knowledge on TQM in the health sector.

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