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Assessing the efficiency of regional hospitals in Ghana: Implications for optimal resource allocation for referral hospitals

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ABSTRACT

Scarcity of resources, high expenditure, and ineffective resource use characterise healthcare in Ghana. The symptom of inadequate hospital resource utilisation gave rise to the popular term 'no bed syndrome' in some Ghanaian regional hospitals. Under these circumstances, patients are continually turned away from receiving treatment because of inadequate beds especially in the emergency and surgical units. Therefore, this study assesses the efficiency of four (4) regional hospitals in Ghana in 2020. Secondary data on bed occupancy rates, average length of stay and bed turnover rates, among others, were collected from District Health Information Management System (DHIMS) for further analysis. Pabón Lasso charts were drawn using Microsoft Excel 2019 to evaluate the efficiency level of hospitals and wards. The results show that the Greater Accra and Brong Ahafo Regional Hospitals were inefficient, the Upper East Regional Hospital was less efficient and the Eastern Regional Hospital was efficient. Findings also indicate that the medical, maternity and surgical wards of the Brong Ahafo Regional Hospital were inefficient. However, the emergency ward was the most efficient in the Eastern Regional Hospital but that of the Upper East Regional Hospital was inefficient. The medical and surgical wards of the Greater Accra Regional Hospital were less efficient. These findings have practical implications for designing policy instruments to promote healthcare delivery in Ghana.

Introduction

Following the Alma Ata Declaration in 1978, several countries adopted strategies to improve the effective delivery of health services [1,2]. This initiative witnessed the establishment of various types of healthcare systems worldwide [2]. In every health system, hospitals are acknowledged as important service-rendering units. Hospitals provide and extend healthcare services to patients, and also serve as the first point of contact for referrals [3]. The performance of hospitals has a significant impact on the overall performance of the health sector. However, hospitals consume enormous health resources with varying levels of expenditure across countries [4,5]. In Europe, hospitals accounted for 38% of total health expenditure in 2016 [6]. The situation is similar in Sub-Saharan Africa, where

Abbreviations: ALOS, average length of stay; BOR, bed occupancy rate; BTR, bed turnover ratio; DHIMS, district health information management system; ERH, eastern regional hospital; UERH, upper east regional hospital; BARH, brong ahafo regional hospital; GARH, greater accra regional hospital; CHPS, community health planning and services.

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hospitals account for 50-80% of total health expenditure. For instance, in Ghana, hospital operations consume more than 60% of the Ministry of Health's (MoH) recurrent budget [7].

The significant increase in hospital resource utilisation necessitates the need to evaluate hospital performance by measuring its efficiency. One of the primary goals of Africa's healthcare system is increased efficiency. African health policymakers have also emphasised the importance of making efficient use of the health sector's limited resources. A growing number of African countries are conducting health facility efficiency studies to help guide the development of interventions to reduce the waste of scarce healthcare resources [8]. An efficient hospital delivers the best healthcare to ensure healthy living and promote well-being to its patients. This is in consonance with the Sustainable Development Goal 3 (SDG 3).

In Ghana, healthcare provision is organized at three levels namely; primary, secondary and tertiary healthcare provision. Regional hospitals are secondary healthcare facilities that serve their respective provinces and serve as referral centres to the primary healthcare centres (Community Health Planning and Services (CHPS), Clinics, Polyclinics, Maternity homes, Health centres and District hospitals). Regional hospitals have relatively high bed capacities and are mandated to provide curative, health promotion, and preventive services [7]. They have specialists such as gynecologists, pediatricians, dentists, orthopaedic specialists and ophthalmologists who handle specific health needs that cannot be adequately treated by primary healthcare facilities. The regional hospitals also refer more complex medical cases such as cases requiring open-heart or neuro-surgery that are beyond their capacities to the tertiary hospitals (teaching hospitals).

Inefficient resource management and low profitability of most regional hospitals, among others, have been reported in literature [9, 10]. Scarce resources, coupled with an inefficient use of hospital resources give rise to the popular term `no bed syndrome` among some regional hospitals in Ghana. Under this situation, patients are constantly turned away from accessing healthcare due to the unavailability of beds especially in the emergency and surgical units [11].

Few studies have been conducted on hospital efficiency in developing countries. For instance, Achoki et al. [12] investigated technical and scale efficiency in the delivery of maternal and child health services in Zambia. They used Data Envelopment Analysis (DEA) to assess the performance of subnational units across Zambia after controlling for environmental factors that were beyond the control of health system decision-makers. They found that the average technical efficiency concerning improving child survival was 61.5%. In Iran, Kakemam et al. [13] used DEA and the Tobit model to analyse the technical efficiency of hospitals in Tehran. They found 17 hospitals to be technically efficient and efficiency can be affiliated with social security. Public hospitals were found to be more efficient than private hospitals. Hatam et al. [14] also employed DEA to measure the technical, scale and economic efficiency of 21 general public hospitals in Fars Province, southern Iran. They found 15 hospitals to be technically efficient. However, the study did not include referral-level hospitals such as regional hospitals which handle cases requiring the services of specialists.

Bobo et al. [15] also used DEA to examine the technical and scale efficiency of the health centres in Ethiopia. The findings revealed that 8 out of 16 health centres were technically efficient. Although health centres are also important healthcare delivery centres, they have low bed capacities and do not house all the essential wards in a health facility. Many studies also highlighted variations in the efficiency of hospitals across different countries using the econometric models [16–24]. However, the use of econometric models including DEA and stochastic frontier analysis is highly technical and may be difficult for healthcare providers to use in measuring efficiency. Besides, these models do not make use of routine data such as BOR, the ALOS and turnover per bed in measuring efficiency. The use of Pabón Lasso analysis to measure hospital efficiency as an alternative to econometric methods of measuring hospital efficiency is simpler. Pabón Lasso analysis is a simple and less complex ratio analysis. A diagram incorporates three ratios: BOR, BTO, and ALOS [6,25].

Mehrtak et al. [26] jointly used the DEA and Pabón Lasso Model to assess the performance of hospitals in Iran's Eastern Azerbaijan Province. They emphasised that both modes rendered complementary and corroborative outcomes on the efficiency of hospitals. A similar result was produced by Ajlouni et al. [27] who assessed public hospitals in Jordan using the two models. Nonetheless, these studies failed to consider wards efficiency which outlines the performance of every unit of the hospital. Shaqura et al. [25] evaluated the performance of Palestinian public hospitals in 2016, 2017 and 2018 using the Pabón Lasso model. They reported that surgical departments were about 42.8% efficient during the 3 years. Only one hospital was relatively efficient (Zone 4) in 2017 and 2018. In internal medicine departments, 28.6%–42.8% of hospitals were efficient, 14.3%–42.8% were inefficient, and 28.6%–42.8% were relatively efficient (Zone 2 and 4). Aloh et al. [28] also used the same approach to determine the efficiency level of teaching hospitals in Southeast Nigeria. They found that there is a high level of inefficiency in Nigerian teaching hospitals. In Iran, Khalilabad et al. [29] assessed the clinical and paraclinical departments of military hospitals. The results indicated that one and two hospitals were efficient in the years 2017 and 2018, respectively.

Furthermore, Qodoosinejad et al. [30] evaluated the efficiency of hospitals in Iran over 5 years. They found that 26% of the hospitals were efficient. A similar study was also conducted by Mousavizadeh et al. [31], Parvaresh and Esfandnia [32], Mahapatra and Berman [33] in Iran, India. Nabukeera et al. [34] evaluated the performance of wards in health centres in Kampala, Uganda. Findings indicated that 2 wards were efficient, 3 wards were less efficient, and 5 wards were inefficient, which represented unacceptable levels of technical deficiency. These articles presented the measurement of hospital efficiency using general hospital outcomes, without effort of measuring the efficiency of individual hospital wards.

Generally, there is a paucity of literature measuring the efficiency of regional hospitals and individual wards using the Pabón Lasso analysis, especially in developing countries, even though data is always available for this analysis. The study also considers it vital to evaluate the performance of the regional hospitals amid global coronavirus emergencies. This study therefore aimed to fill this lacuna. The findings of this study would be useful to policymakers and hospital administrators in using a simple efficiency assessment tool to measure the performance of hospitals.

Methodology

Study design

This is a retrospective cross-sectional design that provides a snapshot of information on the efficiency of regional hospitals from 2018–2020 in Ghana.

Sampling methods

Ghana is divided into three main ecological zones, namely northern, middle and southern zones. The northern zone consists of 5 regions, the middle zone also has 5 regions and the southern zone has 7 regions. We used random sampling method to select 1 regional hospital from each of the zones. Upper East Regional Hospital (UERH) was selected to represent the northern zone. The regional hospital provides referral services to 96 health facilities, including 20 hospitals, 67 health centres, 38 clinics, 3 private maternity homes, 488 demarcated CHPS zones, 395 functional CHPS zones, and 224 CHPS compounds. Furthermore, the doctor-to-population ratio in the region is 1: 24,124, while the nurse-to-population ratio is 1:313.

Brong Ahafo Regional Hospital (BARH) represented the middle zone. The facility administers health services to all the 3 regions within the middle zone. The regional hospital attends to referral cases to 461 health facilities in Bono Region, 96 in Ahafo Region and 366 in Bono East Region. BARH has various specialities including paediatrics and maxillofacial surgery.

Eastern Regional Hospital (ERH) provides referral services to 1225 health facilities comprising Community Health Planning and Services (CHPS) facilities, clinics, maternity homes, health centres, polyclinics and district hospitals.

However, we purposively selected the Greater Accra Regional Hospital (GARH) which is located in the southern zone because it hosts Ghana's national capital and has unique characteristics compared with all other regions. The GARH provides referral services to 707 CHPS facilities, 299 clinics, 101 maternity homes, 32 health centres, 22 polyclinics, and 111 hospitals within its catchment area.

Data collection

The study relied on three years (2018–2020) of secondary data collected from the Ghana Health Service through the District Health Information Management System (DHIMS). DHIMS is a software used to document data that is routinely generated from all public healthcare facilities in the country for analysis. The data used for analysis include Average Length of Stay (ALOS), Bed Occupancy Rate (BOR), Bed Turnover Rate (BTR), admission, number of beds, and inpatient days.

Data analysis

The Pabón Lasso graphical model was used to assess the hospital's performance. In this model, three indicators are used to assess

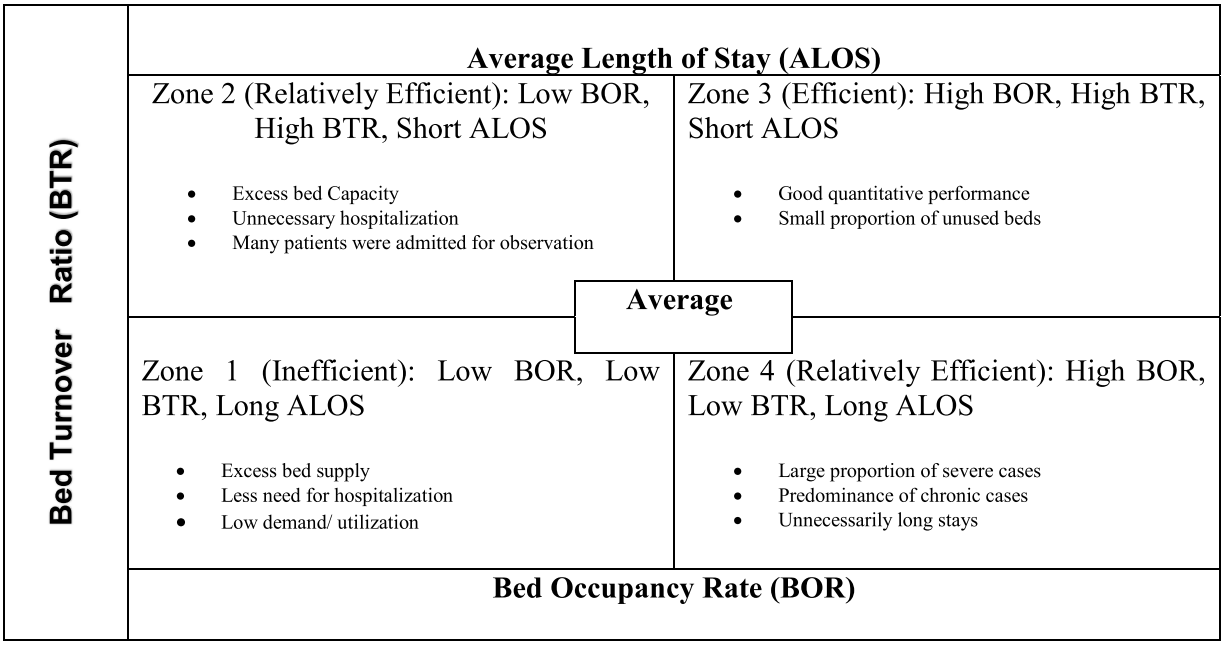

Fig. 1. A conceptual framework for the Pabón Lasso model for evaluation of hospital performance.
Note: Average Length of Stay (ALOS), Bed Occupancy Rate (BOR), Bed Turnover Ratio (BTR).

hospital performance: bed occupancy rate (BOR), bed turnover rate (BTR), and the average length of stay (ALOS) [35]. BOR is the percentage of available beds in a hospital that are occupied by patients. BTR is the average number of admissions per bed, and ALOS is the number of days between admission and discharge for each inpatient [36]. The Pabón Lasso Model is a four-zone diagram formed by two intersecting lines of the average BOR and bed occupation turnover. The *y*-axis represents the BTR, and the *x*-axis represents the average BOR [36]. Figure 1 below shows the conceptual framework of the Pabón Lasso diagram.

A self-constructed checklist was used to collect data on the number of active beds, the number of inpatients, occupied bed days and active bed days for each hospital. Then, the following formulas were used to measure the BOR, BTR and ALOS indicators:

$$BOR(\%) = \frac{Occupied\ bed\ days}{number\ of\ active\ bed\ days} \times 100$$

$$BTR = \frac{total\ number\ of\ admissions}{average\ number\ of\ active\ beds}$$

Where, bed days = number of beds × 365

$$ALOS = \frac{sum\ of\ occupied\ bed\ days}{total\ number\ of\ admissions}$$

Pabón Lasso's diagram categorised hospitals into four zones: 1. Hospitals with a low BTR and a low BOR, indicating a large number of hospital beds relative to available demand; 2. Hospitals with a high BTR and a low BOR, indicate excessive and unnecessary hospitalisation; a large number of beds; and/or the use of hospital beds for patients with minor problems. 3. Hospitals with a high BTR and BOR. This zone denotes hospitals that have achieved an appropriate level of efficiency, with a low number of unoccupied beds. 4. Hospitals with a high BOR but a low BTR. Typically, these hospitals have patients with chronic diseases who require longer hospital stays or who have unnecessarily long stays.

Results

General description

Table 1 shows the performance indicators of the selected regional hospitals in Ghana over 3 years (2018–2020). The data show that the ALOS of the 4 regional hospitals was 5.65, 6.98 and 7.21 in 2018, 2019 and 2020 respectively. This implied that inpatients spent 5 to 7 days in regional hospitals in Ghana. The average BORs were 77.02%, 72.5% and 74.22% for 2018, 2019 and 2020 respectively. This indicated that larger proportion of hospital beds are occupied by patients. The average BTR of the hospitals were 80.1%, 70.05% and 67.79% in 2018, 2019 and 2020 respectively. We noted that patients per bed per year fallen drastically over the 3 years.

Table 1 shows that ALOS has generally been increasing since 2018. BOR is relatively stable in the period, but BOR has been dropping drastically across the four regions. Figure 2 shows the efficiency level of four regional hospitals in 2020 using the Pabón Lasso graph. Our results show that the ERH was efficient (Zone 3) however, GARH and BARH were inefficient (Zone 1). The UERH was relatively efficient (Zone 2).

Table 2 shows ALOS, BOR and BTR for emergency, medical, maternity and surgical wards of the 4 regional hospitals in Ghana for 2020 records indicate that the medical and surgical wards had the highest ALOS across all the regional hospitals over the period. The ALOS for the medical wards ranged from 4.6 to 23.7 days whereas the surgical wards ranged from 3.6 to 17 days. The ALOS for emergency wards ranged from 1.5 to 4 days. The ALOS of maternity ranged from 2 to 4 days. UERH had the least ALOS while the GARH had the highest ALOS for both medical and surgical wards. BARH had the lowest ALOS for emergency cases whereas the ERH had the highest ALOS for medical cases.

The BOR for the emergency wards ranged from 37.7 to 227.1 whereas the maternity wards ranged from 43.5 to 107.7. The BOR of surgical wards ranged from 32.1 to 107.7 whereas that of the medical wards ranged from 23.7 to 84.5. The results indicate that the ERH recorded the highest BOR for emergency and medical cases whereas the UERH had the lowest BOR for emergency cases. The GARH recorded the highest BOR for surgical cases whereas BARH had the least BOR for surgical cases.

The average BTR of maternity wards ranged from 60.1% to 161.4% while the BTR for surgical wards ranged from 2.9% to 54.7%. The BTR of emergency wards ranged from 62.2% to 209.1% whereas that of the medical wards ranged from 13% to 23.7%. The results

Table 1
Performance indicators of regional hospitals.

	Regional Hospitals	Average Length of Stay (ALOS)			Bed Occupancy Rate (BOR) %			Bed Turnover Rate (BTR)		
		2018	2019	2020	2018	2019	2020	2018	2019	2020
1	ERH	5.08	9.7	10.5	85.13	68.33	110.5	69.9	34.8	76.28
2	BARH	5.45	6	6.3	67.43	66.2	46.05	87.03	84.98	59.8
3	UERH	3.43	3.03	3.2	80.2	74.63	69.03	99.45	101	84.83
4	GARH	8.63	9.2	8.83	75.3	80.83	71.3	64.03	59.4	50.23
	Total	5.65	6.98	7.21	77.02	72.5	74.22	80.1	70.05	67.79

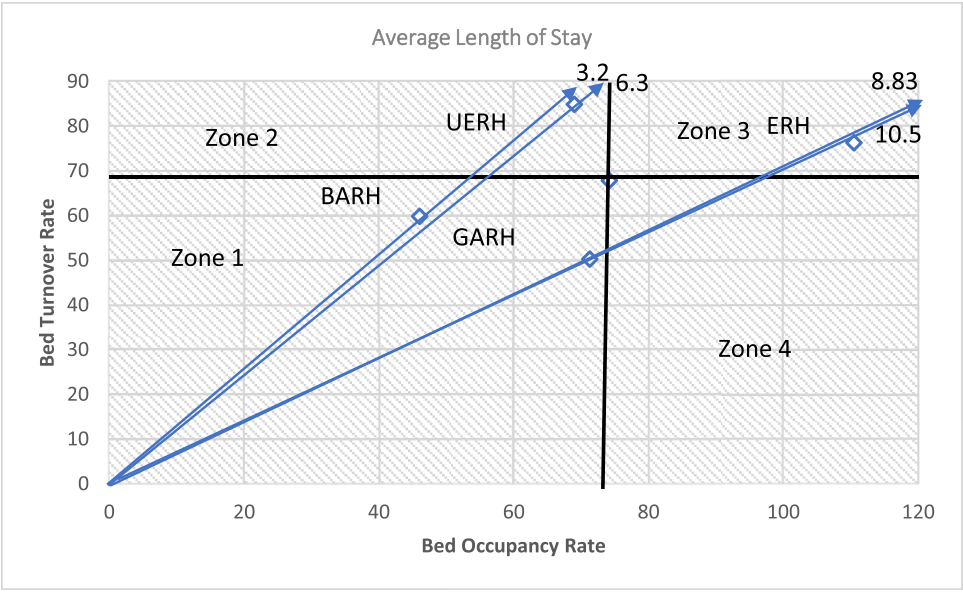

Fig. 2. Efficiency of regional hospitals in 2020 using the Pabón Lasso diagram.

Table 2
Performance indicators of regional hospital wards (2020).

	Regional Hospitals	Wards	Average Length of Stay (ALOS) 2020	Bed Occupancy Rate (BOR) % 2020	Bed Turnover Rate (BTR) 2020
1	ERH	Emergency	4	227.1	209.1
		Medical	23.7	84.5	13
		Maternity	4	66.2	60.1
		Surgical	10.3	64.2	22.9
2	BARH	Emergency	1.5	58.8	142.2
		Medical	14.3	49.8	12.7
		Maternity	2	43.5	64.8
		Surgical	7.4	32.1	2.9
3	UERH	Emergency	2.2	37.7	62.2
		Medical	4.6	76.7	61
		Maternity	2.4	107.7	161.4
		Surgical	3.6	54	54.7
4	GARH	Emergency	3.1	84.3	98.8
		Medical	11.6	75	23.7
		Maternity	3.5	62.3	64.8
		Surgical	17.1	63.6	13.6

show that the UERH had the highest BTR for maternity and surgical cases whereas the ERH recorded the least BTR for maternity cases but had the highest BTR for emergency cases.

Figures 3–6 show the efficiency of regional hospitals by wards in 2020 using the Pabón Lasso graph. The results in Fig. 3 show that the emergency ward of the ERH was efficient (Zone 3). The GARH and UERH were inefficient (Zone 1) whereas the BARH was relatively efficient (Zone 2).

In terms of medical wards (Fig. 4), the UERH was efficient (Zone 3), the BARH was inefficient (Zone 1), and Greater Accra and the ERH were relatively efficient (Zone 4).

Regarding maternity wards (Fig. 5), the UERH was the most efficient (Zone 3) whereas that of the GARH, ERH, and BARH were inefficient (Zone 1).

With respect to the surgical wards (Fig. 6), the UERH was efficient (Zone 3) whereas, the GARH and ERH were relatively efficient (Zone 4), and the BARH was inefficient (Zone 1).

Discussion

Performance of regional hospitals based on individual efficiency indicators

A comparison of the general performance of the four regional hospitals over 3 years, based on the individual efficiency indicators is

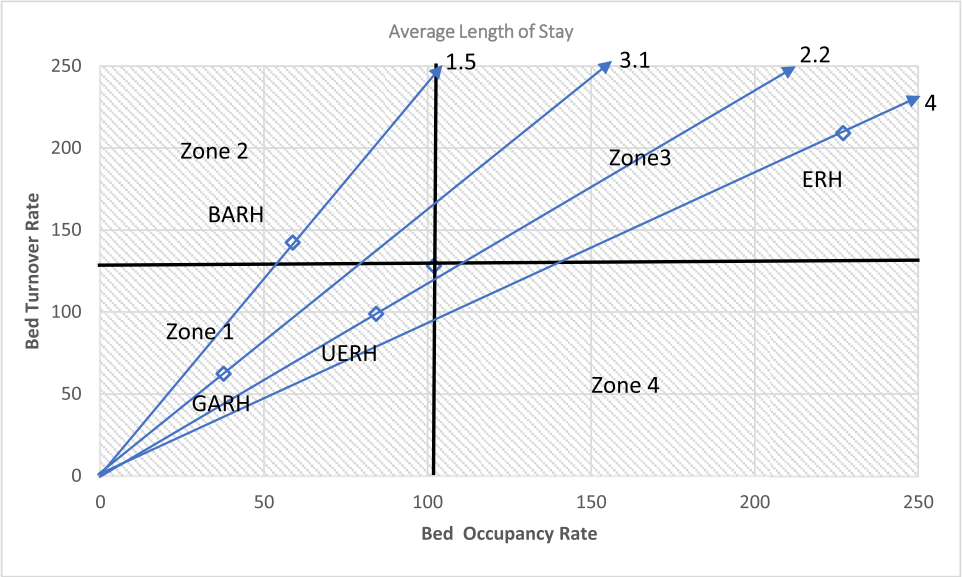

Fig. 3. Efficiency of emergency wards in 2020 using the Pabón Lasso diagram.

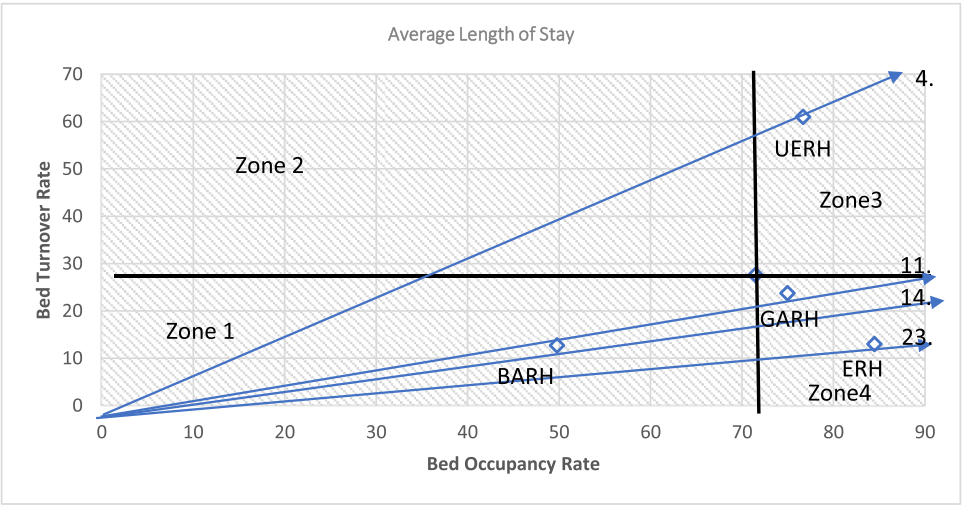

Fig. 4. Efficiency of medical wards in 2020 using the Pabón Lasso diagram.

shown in Table 1. The results show that the ALOS of the four regional hospitals over the three years was 6.61 days. This implies that inpatients stayed longer on admission in the regional hospital. A study conducted in Indian and Egyptian hospitals showed similar results, where the ALOS were 6.3 and 7.75 days, respectively [18,33]. According to Khalilabad et al. [29], the benchmark for the ALOS should be 4.2 to 4.7 days for general hospital cases. Longer ALOS may be a reflection of inefficient hospital resource use. The effect of prolonged bed stay increases hospital costs both to the patient and the healthcare providers and also pose a risk for nosocomial infections [34,37]. A shorter ALOS, on the other hand, is preferred as it reflects the efficient use of hospital resources. However, this depends on the nature of the illness. The length of stay for acute illnesses is generally expected to be shorter, whereas that of chronic and orthopaedic conditions tend to be longer[6].

With respect to performance based on ALOS on the wards, the results showed that medical and surgical wards have a longer ALOS compared with emergency and maternity wards (see Table 2). This difference is expected since emergency patients are often detained for a shorter period and then transferred to the medical or surgical wards. On the other hand, pregnant women are usually discharged shortly after normal delivery unless there are complications that may necessitate mothers to stay longer in the maternity wards. The results are consistent with Ghana's Ministry of Health report which indicate that maternity cases spent an average of 3.3 days on admission [10].

Performance based on BOR show that the 4 regional hospitals recorded an average BOR of 74.58%. This is below the general

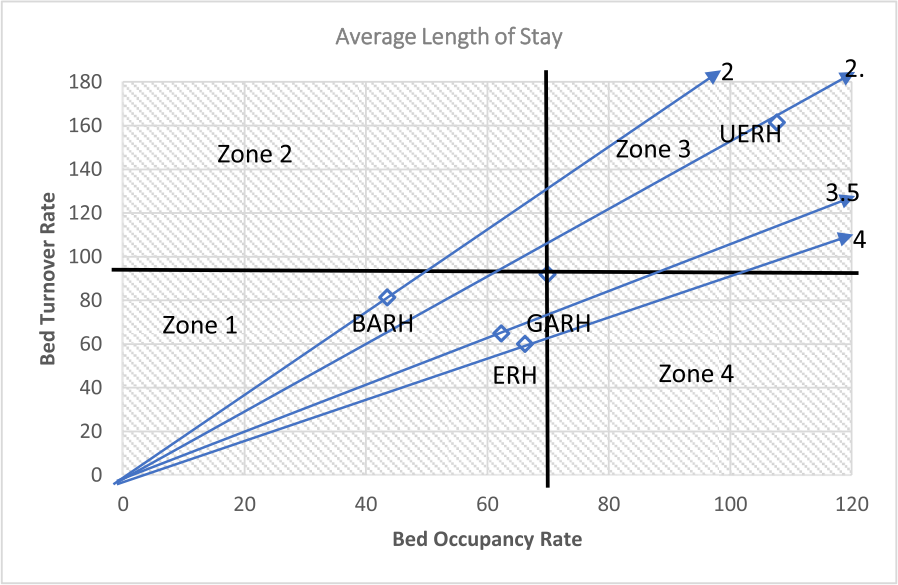

Fig. 5. Efficiency of maternity wards in 2020 using the Pabón Lasso diagram.

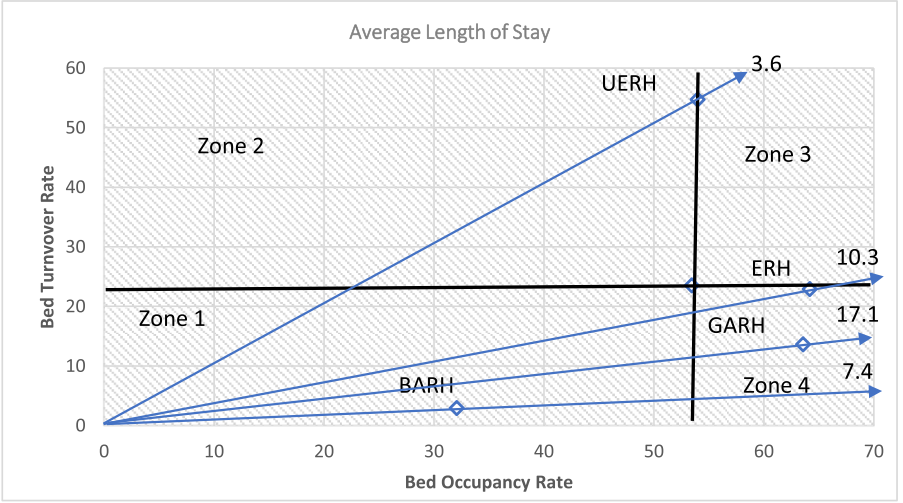

Fig. 6. Efficiency of Surgical wards in 2020 using the Pabón Lasso diagram.

efficient BOR level of about 80–90%. However, it is greater than the national average of 48.2% in 2020 [10,30]. The relatively low BOR is less desirable as it implies that beds in the regional hospitals were operating below the optimal level. The low BOR also implies that there were few referral services from district hospitals within the catchment areas of the regional hospitals. Another plausible explanation is that district hospitals have improved their service delivery, resulting in fewer referrals to regional hospitals. Findings from the literature on BOR are mixed. Bahadori et al. [17] and Kavosi et al. [19] report that 4 out of 14 hospitals had BOR indicators higher than the standard level but the rest were below. However, Arzamani et al. [16] reported a relatively higher BOR than the national standard for hospitals in North Khorasan province of Iran. In Singapore, Zhu [24] indicated that public hospitals recorded BOR of approximately 90%. A study conducted by Elayyat and Sadek [18] on specialist hospitals in Egypt reported that BOR increased from 54.3% to 86.3% over a decade.

With respect to performance based on BTR, the findings show that the average BTR of the four hospitals was high (72 patients per bed per year). Parvaresh and Esfandnia [32] indicated that the desirable rate of BTR should be about 17 patients per bed per year. Aloh et al. [28] reported a BTR of 22 patients per bed per year in teaching hospitals in Southeast Nigeria. High BTR implies that a greater number of clients are admitted, showing improved hospital productivity, and decreasing average cost per admission.

Efficiency of the regional hospitals

The general efficiency levels of the four hospitals, as shown in the Pabón Lasso diagram (see Fig. 2), suggests that the ERH was the most efficient regional hospital among the 4 regional hospitals examined (Zone 3). This tendency for few hospitals out of many to be efficient, is consistent with previous studies [17,26,27,35]. For example, Ajlouni et al. [27] indicated that 7 out of the 15 public hospitals were efficient in Jordan, while Goshtasebi et al. [35] also revealed that only 2 hospitals were efficient in the province of Kohgilooyeh and Boyer-Ahmad, Iran.

We found that the UERH was relatively efficient (zone 2). The findings is corroborated by Rezaei et al. [23] who reported that 4 out of 15 hospitals in Iran were less efficient. The GARH and BARH were found to be inefficient (zone 1). This suggests that the hospitals have more beds than the demand for them. It also implies that there was less need for hospitalization or low demand for the services of the two hospitals. These results support the findings of the previous studies by Moradi et al. [21].

Efficiency by wards

Reviewing the efficiency of the regional hospital in terms of wards (see Figs. 3–6). We found that the emergency ward of the ERH was efficient (Zone 3). This implies that the emergency ward of ERH had achieved good quantitative performance with few of the beds unused, reflecting efficient management of the resources [28]. However, the emergency ward of the BARH was less efficient (Zone 2). This implies that the ward had excess bed capacity to take care of patients or embarked on unnecessary hospitalisation of patients in the ward. The emergency wards of the UERH and GARH were inefficient (Zone 1). This suggests that the wards had excess supply of beds, less need for hospitalisation and low utilisation of hospital beds in the wards. Khalilabad et al. [29] also indicated that wards of military hospitals were inefficient in Iran.

In terms of medical wards, we realised that UERH was the most efficient (Zone 3). The ward managers adopted prudent management in the use of the scarce resource. The medical ward of the ERH and GARH were less efficient (Zone 4). This implies that the medical ward of the hospital recorded large proportion of severe cases or chronic cases. Therefore, patients spend more than expected days resulting in relatively low BTR [33]. The medical ward of the BARH was inefficient (Zone 1).

The results show that the maternity wards of the UERH were efficient (Zone 3) whereas those of the BARH, ERH and GARH were inefficient. This implies that the maternity ward of the UERH recorded high number of deliveries with a relatively shorter ALOS. The presence of well-qualified midwives results in improving the quality of the provided services which enhances productivity and shortens hospital stays [22]. The reasons for the inefficient performance of the three remaining regions are that anecdotal reports indicated that during the climax of the covid-19 pandemic in Ghana, many pregnant women who feared contracting the virus by visiting the hospital, decided to give birth at home, assisted by traditional birth attendants. This situation rendered the maternity wards of hospitals largely redundant.

With regard to the surgical wards, that of the UERH was efficient (Zone 3). This implies that many surgeries were performed and fewer beds were left unused. This finding is consistent with Kalhor et al. [3] which found the surgical ward of the Qazvin University of Medical Sciences to be efficient. However, the surgical wards of the ERH and GARH were less efficient (Zone 4), this was probably because the hospital wards recorded severe of chronic surgical cases which required higher days of hospitalization, or surgical patients stayed unnecessarily longer. The surgical ward of the BARH was inefficient (Zone 1). This could be due to less demand for elective surgeries as result COVID-19.

Conclusion and recommendation

This study assessed the efficiency of regional hospitals in Ghana. On hospital-wide basis, the findings show that ERH was efficient, UERH was less efficient, and GARH and BARH were inefficient. In terms of unit or ward level, the ERH was efficient in emergency and surgical wards, whereas UER was efficient in medical and maternity wards. It is recommended that inefficient and less efficient hospitals should put measures in place to become efficient. They should also learn from the best practices of efficient hospitals, either at the general hospital or unit levels. Further study is needed to explore the reasons for efficiency levels in the hospitals studied.

Limitations of the study

The study studied the efficiency for four regional hospitals instead of all ten regional hospitals in Ghana. This is because of the unavailability of efficiency data or incomplete data to study the efficiency of the other regional hospitals. Findings are also based on the assumption that efficiency data received from the hospitals studied are accurate. Where there are inaccuracies, the findings may not be valid. There is need to take a critical look at the computation of efficiency indicators Ghanaian hospitals to ensure accurate reporting. In future it would be beneficial to assess the efficiency of primary hospitals that refer cases to the regional (secondary) hospitals, since they are more than regional hospitals in Ghana. Notwithstanding these limitations, the study provides insight into the use of efficiency indicators generated by health facilities to do further efficiency analysis to inform policy and practice.

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CRediT authorship contribution statement

Enoch Yao Vukey: Conceptualization, Data curation, Methodology, Formal analysis, Writing – original draft, Writing – review & editing. **Gloria Ntow-Kummi:** Conceptualization, Data curation, Writing – review & editing. **Aaron Asibi Abuosi:** Conceptualization, Formal analysis, Methodology, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgment

Not applicable.

If you want to read more about the method we applied, the Pabón Lasso model is available via this link. https://iris.paho.org/bitstream/handle/10665.2/27221/ev20n4p341.pdf?sequence.

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