

The effects of market concentration on health care price and quality in hospital markets in Ibadan, Nigeria

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ABSTRACT

Evidence about the Nigerian health indicators show that the quality of health care in Nigeria is low and inflation of health care prices also persists. Theoretically, by observing the market concentration, inferences can be drawn as to how hospitals conduct themselves, which allows the evaluation of the market performance. Therefore, the effects of market concentration on the health care price and quality were examined.

Market concentration was measured by Herfindahl Hirschman Index (HHI) and four hospital concentration ratios (CR₄). The values of HHI were disaggregated into the less and more concentrated markets. Quality of health care was measured by the staff-nurse-patient ratio. Ordinary Least Square (OLS) was used to estimate the effects of market concentration on price and quality of health care.

The price of health care was found to be 13.4% lower in the less concentrated markets than in the more concentrated market. Income significantly and positively influenced health care prices by 17.8%. Also, a low HHI lead to 33.4% increase in Staff-nurse Patient Ratio (SPR) indicating that the quality of health care was higher in less concentrated markets as hospitals increased the treatment intensity via staff-nurse patient ratio.

A less concentrated market is linked with higher health care quality and lower health care prices. Therefore, a strategy that will reduce market concentration so as to enhance consumer welfare in terms of price and quality is recommended.

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Introduction

Globally, the dramatic change in the hospital markets tends to alter the hospital market concentration with a significant impact on the cost, price, and quality of health care. These changes include the exit and entry of hospitals, the number of hospitals, and ownership structure of hospitals among others. This situation has led to substantial research interest on the impact of market concentration on the quality of health care in particular [1]. The number of hospitals is falling around the world, the American Hospital Association (AHA) Annual Survey of Hospitals (2011, 2015), reported that hospitals reduced in number from 5810, in 2000 to 5795 in 2009 with a further reduction to 5564 in 2015 and 5534 in 2016 in the US [2]. In Canada, more than 275 hospitals have been closed, merged, or converted to other types of facilities between 1996 and 2001 (Canadian Institute for Health Information 2001) [1]. In Taiwan, the number of small community hospitals fell from 388 in 2003 to 327 in 2012 as 218 small hospitals were closed or relegated to local clinics [3]. In Nigeria,

no significant number of hospitals were added to the estimated 3,363 secondary and tertiary hospitals reported to exist since 2004 [4]. In 2016 top markets on medical devices country case study reports that Nigeria had 134,000 hospital beds in 2014, which equal 0.8 per thousand populations and nearly 3,534 hospitals, of which 950 were owned by the public [5]. Also, the presumably few existing hospitals in Nigeria, by their nature lack the capacity to compete in a market-driven economy as they are confronted with challenges of inadequate funding and bureaucratic impediments that threaten their existence [6]. This condition increases market concentration as the figure of hospitals reduces. It also raises the issue of health care quality which amounts to inadequate provision of health care services.

Strict government regulations are meant to ensure the quality of health care, but they decrease the number of hospitals, consequently increase market concentration [7]. In view of the delicate nature of human life, strict regulations in the form of legal requirements to

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set up private hospitals are usually put in place to ensure minimum quality standards in the delivery of health services. In Nigeria, there are regulations that guide the conduct of hospitals and these regulations are ensured by various regulatory bodies. There is ministry of health at the federal level and Medical and Dental Council of Nigeria (MDCN), which supervise the conduct of professionals and ensures that only person who is approved by the council practice as a doctor in Nigeria [8]. Also, there is state ministry of health, which licenses and monitors private health institutions through its departments such as Health and Hospital Monitoring (HHM) and secondary health care and training unit [9]. There are also monitoring agencies that operate at the federal and state level like the Hospital Management Board. Also, the MDCN supervises the conduct of professionals and ensures that only a person who is approved by the council practice as a doctor in Nigeria [8]. All these regulatory measures are meant to ensure the provision of safe, quality, affordable, adequate, equitable, and accessible health care services to all people in Nigeria. However, these regulations often stand as barriers to entry of new hospital and lead to the exit of some existing hospitals. Apart from the legal requirement for setting up hospitals, there are barriers such as cost outlay or capital needed for setting up a hospital, which significantly prevents some hospitals from entering the market. Moreover, the dominating power of the few available big-sized hospitals may also impose natural barriers in the form of lower health care prices that may lead to the exit of some small-sized hospitals [10]. However, fewer numbers of hospitals may not support the achievement of improvement in health care services, as it may result to excessive inflation of health care prices, charged by the few hospitals [11].

Furthermore, Life expectancy at birth for a female is 53 years in Nigeria, which is below the average age of 83 years recorded in the least developed countries, World Development Indicator [12]. Preventable infectious diseases like malaria, pneumonia, diarrhea, and measles accounted for more than 70% accounts for one million and five deaths in Nigeria [13]. These indicators showcase the lower quality of health care and the causes of lower quality health care are inadequate funding of hospitals, high market concentration, and lack of proper supervision of the health system [6,14]. Owing to lack of proper supervision, some private hospitals do not comply with the ministry of health's standard and too few regulations have been enforced to ensure that hospitals meet up with the minimum quality standard requirement [15]. Producing lower quality health care amounts to patients paying for health care

services that are unsatisfactory and it tends to worsen health status, leading to complications that may result in disabilities or support the untimely death of millions of people since health care services and quality are inextricable [16]. Thus, to address these problems, there is a need to observe the market concentration so as to draw inferences about hospital conducts, which are the basis for the evaluation of market concentration. Some anticompetitive conducts have been attributed to a certain level of market concentration by influencing the number of hospitals and market power with attendant effect on price and quality of health care. Therefore, examining how market concentration relates to the price and quality of health care in the hospital markets is the focal issue of this study.

Literature review

A. The Nigerian Health Care System and the Classifications of Hospitals in Nigeria

The management structure of the Nigerian health care system is decentralized at the three levels of government. The 1999 Constitution puts health on the concurrent list, meaning that all tiers of government have a definite role to play in providing for the people's health needs. At the federal government level, the Ministry of Health is in charge of providing technical assistance to the overall health system and delivering health services through the tertiary and other health care facilities. At the State level, the ministry of health regulates the secondary hospitals and also provides technical support for primary health care, while the governments at the local level are directly responsible for the provision of health care for people at the local level. There are various health parastatals, agencies, and departments within the federal and state ministries of health, whose activities are coordinated by the National Council on Health, while the Federal minister and state commissioner for health control the federal and state ministries, respectively [17]. These classified organizations of the health system should allow the effective functioning of the health system, but the performance of the Nigerian health sector is still described as poor. There is an absence of clarity of roles among the tiers of government who are responsible for the poor state of the health sector in Nigeria [18].

Hospitals contribute greatly to the operation and activities in the health sector as they are part of health care facilities [19]. A hospital is not just a building, but a complex social institution, which comprises of many groups representing a wide variety of interests and diverse needs that utilizes and services of various

medical personnel to render all the needed healthcare to the patients in its custody [6]. They are geographically dispersed and categorized based on the various health care services they provide. Each hospital is responsible for a wider range of services as well as functional units, such as diagnostic, treatment functions, hospitality functions, and inpatient cases [6]. There are tertiary and secondary hospitals, the tertiary hospitals are the highest level of health care facilities; they provide highly specialized services, chronic-care services in Nigeria. They include specialist hospitals, teaching hospitals, and Federal Medical Centers. Secondary hospitals are seen mostly as general hospitals where patients stay for short-term acute-care services. Medical doctors, pharmacists, nurses, and community health officers are the major staff. A secondary hospital provides basic surgical services, supported by beds and bedding for a minimum of 10 patients [8]. These hospitals are controlled by the state governments and private individuals or groups of individuals, the secondary hospitals are largely privately owned [20]. They are further classified based on the ownership structure as public and private hospitals. The private hospitals are further classified based on the profit motive as for-profit and not-for-profit private hospitals. The secondary hospitals accounted for about 98% of all hospitals with 25% for public hospitals and private hospitals contain 73% of the total hospitals. The distribution of secondary hospitals in Ibadan and Oyo state is presented in Figure 1. In Oyo state, 31 public, 173 for-profit private and 8 not-for-profit private hospitals were recorded in 2005, these numbers were much lower in Ibadan with 20 publics, 133 for-profit private and 5 not-for-profit private hospitals. However, in 2015, a significant increase was recorded in the number of

for-profit private hospitals with little or no significant increase in the number of public and not-for-profit private hospitals. This situation points to for-profit private hospitals as the dominant provider of health services, accounting for the largest number of hospitals in Oyo state and Ibadan. By implication, few numbers of public and not-for-profit private hospitals exist in Oyo state and Ibadan hospital markets with attendant implications for the provision of health care by the government and health care prices.

Registration, regulation and financing structures of hospitals in Ibadan, Oyo State

In Nigeria, no person, entity, government, or organization can register or establish a health establishment without having a Certificate of Standards [21]. Thus, the prerequisite to establishment of hospital hinges on obtaining the certificate of standard, which may be obtained by application from the appropriate body of government where the hospital is proposed to be located. The Oyo state ministry of health ensures proper monitoring and accreditation of private hospitals, as well as the provision of quality health care at public and private hospitals, through the Health and Hospital monitoring (HHM) department. HHM monitoring teams do embark on periodic visits to the private hospitals. This function has enabled 80% coverage of registration of private health care facilities to be achieved with 30% coverage of inspection of existing facilities (OSHDP, 2010). Equally, the MDCN endorses degrees and training institutions and supervises the conduct of health professionals. As stated by the MDCN, only a registered practitioner who holds the status of a consultant or

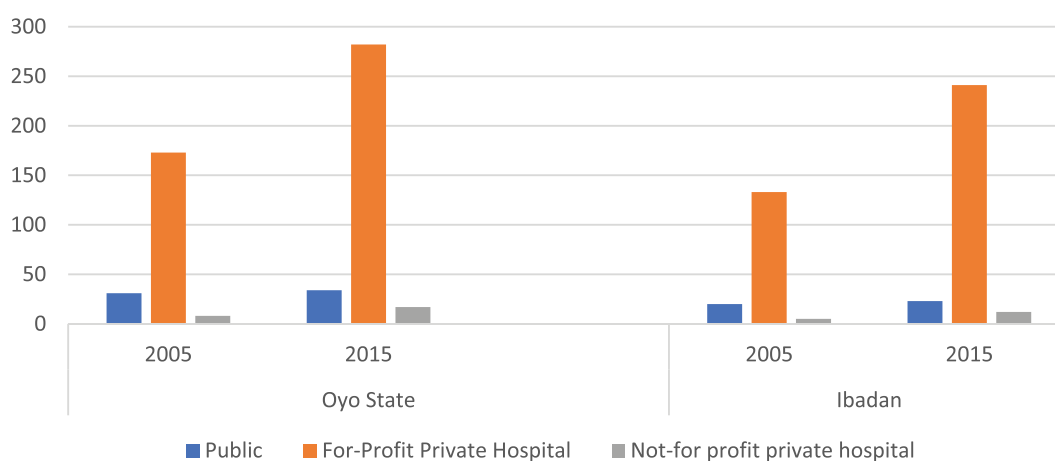


Figure 1. Number and ownership of hospitals in Ibadan and Oyo State (2005 and 2015).

Source: Compiled from OYSMOH and NHIS List of Health Care Facilities (2018)

a medical/ dental officer of more than ten years post-registration experience is allowed to own or manage a private consulting medical institution that will open for business when he is not on official duty. These regulations are meant to prevent unprofessional people (Quack doctor) to own or run any private hospital and to ensure that quality health care is provided at all private hospitals. In public hospitals, there are influxes of qualified doctors and nurses, which represent the hospital's variable inputs, while the fixed inputs include land, buildings, medical equipment, etc. In the state, there are 282 registered medical consultants, 663 medical doctors, 3443 nurses/midwives, and 166 pharmacists available in the local, state, federal, and recognized private health facilities combined together [22]. These resources enhance the health care quality produce in the public hospital and patient's patronage. In Nigeria, public hospitals are equipped with sophisticated equipment and facilities due to their large sizes, although most of these inputs are in a poor state due to lack of maintenance [6]. Some for-profit private hospitals employ the services of a consultant and resident doctors from public hospitals to increase their market share of patients. Although, the employments sometimes are not on a full-time basis, they do this to cut costs, maximize their profit and provide high quality health care. Many of the for-profit private hospitals operate on a small scale with few medical staff, which are usually non-registered nurses (training). They are privately funded and the production of health care requires scarce resources such as capital to purchase hospital facilities and to pay qualified hospital staff. Thus, the cost structure of private hospitals is very high and the increase in the cost of hospital inputs directly impacts on the pricing policy of these hospitals.

B. Market Concentration

In an economic sense, a market is an arrangement that enables consumers and producers to exchange goods and services. Similarly, a market for health care involves buyers and sellers, who interact to trade health care. A market can be imperfect or perfect. A hospital market is imperfect because of differentiated health care services coupled with imperfect information and extensive government regulations [21]. Empirically, hospital market is viewed from two perspectives; firstly, based on related products of interest. Hospital product market is described as hospitals that provide general medical or surgical services, excluding psychiatric and rehabilitation services [23]. It is also defined as an inpatient short-term acute hospital [25]. Secondly, based on related geographical market, which refers to where some or

all of the hospitals within a geographically located area are considered potential competitors of one another [26,27]. There are various methods of defining the geographical related hospital market, these include patient flow, variable radius, and fixed radius methods. After identifying the set of hospitals that offer the product of interest and its geographical area, the market concentration can be examined.

In economics, market concentration is used to determine the firm's number, market shares, total production, capacity, and reserves in the market [28]. Market concentration measures how much market share is concentrated in the hands of few firms and how competitive a market is. A low concentrated market will have many firms with small market shares, while a market with a high concentration will have a few firms with relatively high market shares. As the concentration reduces, competition increases, so also the firm's number [29]. This analysis explains the link between market concentration and the competitive market. As market structure changes from perfect competition to monopoly, market concentration increases, as concentration increases, the market power (ability to influence price) of firms increases. A market with a higher concentration index has a market structure that lies between oligopoly and monopoly, the HHI values can range from 0 to 1, values close to zero indicate that a firm operates in a market between perfect and monopolistic competition, while values higher than 0.18 indicate a market with the dominant hospital or a monopoly [30]. In the hospital market studies, a market with a higher level of competition was used to denote a less concentrated or unconcentrated market [31,32].

C. Linking Theories with Empirical Analyses

The concentration ratio and HHI remain the common measures of concentration in market studies. HHI values range from 0 to 1. A zero value indicates a market with low concentration, while values close to one indicate a market with high concentration [24,25]. Using HHI reveals that hospitals producing the same health services are characterized as being relatively competitive [26]. Some studies found a positive effect of market concentration on the quality using HHI and various quality indicators. Using mortality rates from acute myocardial infarction (AMI) as a measure of health care quality and HHI to measure the market concentration, it was found that the quality of health care increases as patients in the less concentrated markets had mortality probabilities of 1.46 points higher than those in the more concentrated markets [24]. Similarly, low-valued patients received lower quality of health care in less concentrated markets, and high-valued

patients received a higher quality health care in less concentrated markets than in more concentrated markets [32]. This implies that in less concentrated markets, patients are treated according to their health status, while there is a disparity in the quality offered in more concentrated markets. This situation creates a tendency for patient exploitation as hospitals charge higher prices for lower quality of health care which majorly arises from asymmetric information in an imperfect market. Using HHI to measure market concentration shows that changes in patient satisfaction were positively associated with an increase in insurance concentration and a negative increase in hospital concentration indicated that patient satisfaction was higher in less concentrated markets [33]. These findings show that HHI is commonly used to measure market concentration.

The evaluation of the relationship between quality scores for 3 diagnosis groups and hospitals' market share, revealed that hospitals in competitive markets have better quality scores than those in concentrated markets as a negative relationship exists among market share and quality score for 2 of the 3 diagnosis groups studied [34]. Thus, it was concluded that in the Dutch hospital markets, competition is positively linked with quality scores. The assessment of the influence of market competition on quality for stroke inpatient that has health insurance single-payer in Taiwan was done. Quality was measured using the mortality rate and other admission rates. The results show that competition has a negative effect on quality as the mortality rate of stroke patients reduced in moderately and less competitive markets compared to highly competitive markets [35]. Overall, the findings from the literature revealed mixed results about the effects of market concentration on the quality of health care.

The information on movements in prices and the input of health care prices for overall health care growth show that prices account for 60% of the increase in overall spending from 2008 to 2009 [36]. This indicates that the proportion of health expenditure due to prices varies over time. Using Northern Virginia's data, the estimated model of bargaining between managed care organizations (MCOs) and hospitals shows that hospital mergers with MCO bargaining affect hospital prices significantly. It was found that the merger will have a higher average price on the merged hospitals by 3.1%, which is about 30.5% increase in price [37]. Similarly, the effects of market concentration on price were estimated using the new concentration measure of LOCI [38]. The study finds that on average, hospital

prices decline considerably as markets are less concentrated, showing that a supposed merger that decreases the number of firms from 3 to 2 leads to a price increase of 800, USD or 16%.

In developing countries, examining the effect of market concentration on health care quality and price has received little attention. However, in Nigeria, HHI was used with respect to assets and bank deposits. It was found that HHI increased after the bank consolidation exercise and the industry remained largely competitive, as concentration declined slightly [39]. In addition, the study shows that one benefit of the 2004/2005 bank consolidation exercise and other complementary reforms delivered to the banking industry in Nigeria is a slightly less concentrated market, which raises efficiency and profitability. In South Africa, between 2000 and 2011, the concentration of private hospitals was measured by HHI and the results show that competition level increases among private hospitals [40]. In South-South, the patient satisfaction, a measure of quality between private and public hospitals, was found higher in private than in public hospitals [41]. Other studies, also portray that private hospitals offer effective service delivery than public hospitals in Nigeria [42,43]. Also, in sum, mixed findings about the effect of the measures of market concentration on health care quality and price exist in the literature, with mixed conclusions due to different measures of quality.

Methodology

To examine market concentration, this study first delineated the hospital market areas. Different approaches have been used to define a hospital's market [26,44]. These methods include Geopolitical boundaries, fixed radius and variable radius, and patient flow methods, but to cater for endogeneity bias in other methods and because of computational complexities, the patient flow method was adopted. The patient flow method defines a hospital's market as the collection of zip code areas (ZCAs) that send a nontrivial number of patients to the hospital, and that collectively accounted for 75% or 90% of a hospital's attendance. This approach rank ZCAs in decreasing order so that a ZCA that accounts for the largest number of patient attendance is ranked first and a ZCA with the smallest number of hospital patients is ranked last. The core hospital market areas were then defined as the ZCAs that cumulatively accounted for 90% of hospital patients. The 90% was adopted to allow a maximum number of hospital

markets to be selected. Most of the previous studies based their analysis on hospital inpatient, but this study considers outpatients from the general out-patient ward that hospitals have records of.

A. The Measures of Market Concentration

The market concentration is commonly measured by the N-firm concentration ratio and Herfindahl Hirschman Index. A market with many firms and a small market share is apt to be less concentrated than markets in which the number of firms is few with a large market share.

I. Concentration Ratio

The four-hospital concentration ratio (CR_4), were used to measure hospital market concentration. This measure helps to understand how much market share is concentrated in the hands of few firms and to classify how competitive a market is. The CR_4 was obtained by summing the market share of the top four hospitals in the market area and the formula used is expressed as; $CR_4 = S_1 + S_2 + S_3 + S_4$ The market share (S) of each hospital in a particular market area was constructed by dividing the number of patients that attended hospital located within the market area by the total number of patients that live in that market area. It is expressed as;

$$S = \sum_{j=1}^J \left(\frac{n_{jk}}{n_k} \right)$$

Where $j = 1, 2, \dots, J$, $k = 1, 2, \dots, K$,

n_{jk} = patients that attended hospital j from HMA k ,

n_k = total number of patients that live in HMA k ,

The estimated concentration ratios were disaggregated into percentile, so that the first percentile corresponds with the lower CR and less concentrated market, while the second percentile corresponds with higher CR and a more concentrated market.

II. Herfindahl Hirschman Index (HHI)

The merit of using an HHI to measure market concentration is to account for the firm's number in the market and the relative sizes of the firms. The HHI is an index demonstrated as a weighted average of patients of a hospital in the market area that the hospital serves, where the weight simply reflects the market share of the actual patient flow to a particular hospital [26]. This index is the summation of the squared value of each

hospital's market share of patients that attend various hospitals within a given hospital market. HHI is algebraically denoted for hospital j as:

$$HHI_j = \sum_{k=1}^K \left(\frac{n_{kj}}{n_j} \right) HHI_k,$$

$$HHI_k = \sum_{j=1}^J \left(\frac{n_{jk}}{n_k} \right)^2; n_{kj} = n_{jk}$$

$$HHI_k^{pat*} = \sum_{j=1}^J \left(\frac{n_{jk}}{n_k} \right) HHI_j$$

Where;

HHI_j = HHI for individual hospital; $j = 1, 2, 3, \dots, J$

HHI_k = HHI for each hospital market area; $k = 1, 2, 3, \dots, K$

HHI_k^{pat*} = market-patient-level HHI. It is the weighted mean of patients of a hospital from the market area it serves multiplied by HHI for each hospital

n_k = Number of patients who live in a hospital market area k

n_{jk} = Number of patients who attend hospital j and live in a hospital market area k

The equation shows that the market share of patients of a hospital market area that a hospital serve is multiplied by the HHI for each hospital market area. The value of HHI potentially increases when there is a reduction in the number of hospitals. Thus, the ratio of market share of patients to less number of hospitals increases the HHI. The estimated HHI is disaggregated into percentile, so that the first percentile corresponds with low HHI and less concentrated market, while the second percentile corresponds with high HHI and concentrated market.

III. Number of Competitors (N)

The number of competitors within a market is simply a count of the number of hospitals located within the market. The N measure is calculated as the number of hospitals that each market area sends its patients to. Though this approach is easy, it does not capture the relative sizes of firms, which can play an important role in the determination of competition levels. The algebraic description of how to calculate the number of competitors for each hospital in a patient flow hospital market is expressed as;

$$N_j = \sum_{k=1}^K \left(\frac{n_{kj}}{n_j} \right) J_k$$

Where N_j = represent the number of competitors for hospital j from all hospital markets

j Indexes hospital while i indexes individual patient

k = hospital market area where $k = 1, 2 \dots K$

K = Total number of all hospital markets in the geographical area of Ibadan

n_j = Number of patients who attend hospital j from K

n_{kj} = Number of patients who live in a hospital market area k and attend hospital j

J_k = Number of all hospitals attended by patients from a hospital market area k

In equation (1), $\frac{n_{kj}}{n_j}$ represent the ratio of actual number of patients from a hospital market area that attend hospital j to the total number of patients that attend hospital j from all hospital market areas (K). Therefore, an equation for the number of competitors implies the number of competitors faced by the hospital j from all hospital market areas. It is the weighted average of the market areas that a hospital serves while the weight reflects the share of a hospital's patient that live in each hospital market area.

B. Quality and price of health care measurement

I. Quality of health care

In the hospital market, quality is a major issue, its effect on an individual's well-being can be very great, while the importance of quality is undisputed, and the issue of how-to quantity quality is a long-lasting and belligerent. This is because; quality poses a challenge in linking theoretical predictions and empirical findings as different studies employing different indicators. In the literature, quality indicators have been grouped under four measures. First, outcome indicators, these indicators are health outcomes determined (in part) by the quality of health care, such as mortality rates, readmission rates, length of stay, etc [31]. Second, input indicators, which include, staff-patient ratio, number of physicians, etc. They describe the efforts exert by hospitals to demonstrate their commitment to quality in order to attract patients [45]. Third is the process indicator; it measures if the health services given to patients were consistent with routine medical care [1]. Fourth, are the patient quality's experiences, which include measures such as waiting time, number of physicians, etc [46]. This paper employed the input quality indicators, using four (4) hospital's inputs.

II. Health care price

The prices for health care services varies significantly among all hospitals, even for common diagnosis, and it is most times tedious for patients to know their out-of-pocket costs before receiving healthcare, since patients rarely know what they will pay for healthcare services until they have received the healthcare [47]. In Nigeria, hospitals, especially private charge different patients' different prices for the same health care services and

patient with health insurance coverage pay less because of the price bargaining with the Health Maintenance Organizations. In this study, health care price is obtained from two sources; one, from hospital managers/owners for different health care services. Two, from patients that attended hospitals for various health care services. This is because it is possible for patients most times to bargaining with the hospital owners on the price for a particular health care service. Thus, there is variation in the hospital list price and what the patient paid Out-of-Pocket (OOP). Thus, in this article, health care prices refer to a patient's out-of-pocket spending.

C. the effects of market concentration on quality and price of health care

Empirically, the SCP framework is commonly employed to examine the effect of concentration ratio and Herfindahl-Hirschman Index (HHI) on the typical performance measure. There are different methods in using the SCP approach. Some of these methods include Reduced-form and Structural and semi-structural models [31]. The reduced-form method was applied in the empirical modeling of the effect of market concentration on quality and price of health care in this study. This approach is also referred to as the modal approach [37]. It allows researchers to regress HHI on the dependent variables of interest using the OLS, Ordinary Least Square.

Model specification to examine the effect of market competition on the quality of health care

The functional form of the models of market concentration on health care quality and price are expressed as:

$$Z_j = f(CR_{ij}, HHI_{ij}, N_{ij}, D_i, P_i, AVC_j, HCH_j, DUM_{ij}, \epsilon_{ij}) \quad (1)$$

Equation (1) can be re-specified in an econometric model

as:-

$$\begin{aligned} \ln(Z_j) = & \alpha + \delta(CR_{ij}) + \varpi(HHI_{ij}) + \iota(N_{ij}) + \gamma \ln(D_i) \\ & + \beta \ln(P_i) + \ln(AVC_j) + \psi \ln(HCH_j) + \zeta \ln(DUM_{ij}) + \epsilon_{ij} \end{aligned} \quad (2)$$

$$P_j = f(CR_{ij}, HHI_{ij}, N_{ij}, D_i, AVC_j, HCH_j, DUM_{ij}, \epsilon_{ij}) \quad (3)$$

Equation (29) can be re-specified in an econometric model as:

$$\begin{aligned} \ln(P_j) = & \alpha + \delta(CR_{ij}) + \varpi(HHI_{ij}) + \iota(N_{ij}) + \gamma \ln(D_i) \\ & + \ln(AVC_j) + \psi \ln(HCH_j) + \zeta \ln(DUM_{ij}) \\ & + \epsilon_{ij} \end{aligned} \quad (4)$$

$i = 1, 2, \dots, N$ = individual patient sampled for the study,
 $j = 1, 2, \dots, J$ = individual hospital

Where;

HHI = Herfindahl-Hirschman Index

Z = Quality Indicators as measured by the number of full time House officers, registered nurses, hospital beds and staff-nurse patient ratio.

N = Number of competitors

D = Demand Indicators, which are patient income, education, health insurance

AVC = Average Variable Costs

DUM = Dummy variable for hospital location (1 =rural; 0 otherwise)

Price = Average Health care price (Out-of-pocket)

HCH = Hospital Characteristics captured by the number of hospital patients, hospital market share of the bed and location of the hospital.

\square = Error term

C Data and Estimation Strategy

I. Variable description and estimation strategy

Hospitals were conceptualized in this study as medical centers that provide a variety of inpatient and outpatient services 24 hours per day and 7 days per week and that typically have at least one doctor [48]. While Patients refer to those that were on admission and those that attended the general outpatient wards for various health care services. In these analyses, four (4) dependent variables were employed to capture hospital inputs, and these include; the number of house officers, who are doctors qualified to practice a year after graduation from medical school. The numbers of registered nurses who have graduated from a nursing program and meet the requirements outlined by the Nursing and Midwifery Council of Nigeria. The number of available beds in a hospital and the ratio of staff nurses to the available number of patients in a hospital. Thus, each dependent variable presents a model aggregated in the equation (3). The independent variables, apart from the market concentration indices are characterized as patient and hospital variables. The patient variables were the patient's average monthly income from occupation, education, health insurance coverage status, and health care price paid by patients Education represents the level of schooling of an individual patient, which is indicated as dummy variables. The average monthly income and health care price were measured in Naira. The hospital variables are the number of hospital patients, hospital ownership structure, market share of hospital beds, and the hospital average variable costs. The numbers of hospital patients represent the volume of hospital patients

recorded by the individual hospital. Market share of hospital beds is the ratio of a hospital's number of beds to total beds in the market. The average variable costs, measured in Naira are input costs of providing health care services, these costs include the salaries of staff, cost of equipment replacement and maintenance, cost of drugs and supplies. The CR4 and HHI for each market were estimated using Excel workbook. The equations were estimated for each hospital in all the market areas. Ordinary Least Square (OLS) estimation technique was used to estimate the specified regression models. STATA software was used to estimate the regression and multinomial models.

II. data requirement and sources

Data from both primary and secondary sources were used for the purpose of analysis, survey data on hospitals and patients were obtained from primary sources, while information about the possible list of hospitals and their locations play a role in the background of the study. The secondary data were sourced from the Oyo state ministry of health, National Health Insurance Scheme (NHIS) and health departments in LGAs in Ibadan. The zip codes were obtained from the Nigeria Postal Service, Ibadan. Patient data such as average monthly income, educational status, and patient health insurance status was collected directly from the patients via a structured questionnaire. The average value of the minimum and maximum amounts charged by individual hospital for different healthcare services paid by the individual patient as indicated in the patient structured questionnaire was used as the average health care price. Hospital information such as the number of full-time resident doctors and house officers registered nurses, and hospital beds, the average number of hour's doctors spend on duty per day, staff-nurse bed ratio, and patients' quality indicators were collected directly from the hospital's administrators.

The Study Area and Population

The study area covers all the secondary hospitals in Ibadan, Nigeria. It is the capital of Oyo state. Ibadan metropolis has a population of about 1.4 million [49]. It is popularly known as one of the biggest cities in Africa with an area of 3,080 square kilometers. It has 35 zip code areas and the second largest number of private secondary hospitals in the South-West geopolitical zone (NBS, 2014). Ibadan has 11 LGAs with 5 LGAs in urban areas and the remaining 6 in the semi-urban areas.[50] The tertiary hospitals are very few in the study area, therefore, they are excluded and the secondary

hospitals and patients that attended these hospitals were the targeted population. The total number of registered hospitals in Ibadan were 143 out of 436 health care facilities in Ibadan [51]. Also, from the list of all hospitals prepared by the Oyo state ministry of health, the number of secondary hospitals was put at 276 [9]. In order to have a full representation of all hospitals; the registered, those undergoing registration, and those that are yet to register, this study conducted a population census of all secondary hospitals in Ibadan. The number of secondary hospitals found after the census was 185 with 21 public hospitals, 153 for-profit private hospitals, and 11 not-for-profit private hospitals, which represent, respectively 11.4%, 82.7%, and 5.9% of the total population of hospitals found in Ibadan. It may be said that some hospitals were either no longer in existence or have relocated to other areas outside Ibadan.

IV. Sample and Research Instrument

Based on the willingness to participate, out of the 185 hospitals and 1110 patients, 127 hospitals with retrieved questionnaires were employed. Purposive sampling method was used to select 6 patients from the general out-patient department (GOPD) and who were adult within the age bracket of 18–60 years, totaling 762 patients in all. Furthermore, 115 hospitals were finally employed in the analysis based on the 90% hospitals' patient attendance using the patient flow method of related geographical hospital market. The patient and hospital structured questionnaires were employed as the research instrument. Copies of hospital structured questionnaire were administered to the hospital's managers to obtain information about the number of nurses, house officers and resident doctors on a full-time basis, the number of beds, and health care prices. In each hospital, copies of the patient structured questionnaire were administered to both inpatients and outpatients to obtain the source-demographic characteristics such as age, average monthly income, level of education and health insurance coverage status. The data were collected by both the researcher and the trained research assistants to ensure adequate accuracy.

Presentation of Results and Discussion of Findings

Out of the 127 hospitals, 115 hospitals were used based on the 90% hospital patients. The 115 hospitals fell into 15 distinctive market groupings using the patient flow method. For easy interpretation, the values of CR and

Table 1. The values of HHI, CR and market concentration.

Percentile	HHI		CR		Concentration level
	Min value	Max value	Min value	Max value	
1 st	0.0280	.0366	0.26	0.40	Less
2 nd	.04012	0.1916	0.41	0.65	More

Source: Field Survey, 2020

HHI were disaggregated into percentiles. The lower and higher values correspond to less and more concentrated markets respectively. This analysis was used in explaining the OLS results presented in Table 3. The details of the classification are presented in Table 1.

This section is divided into three parts. The first part explains hospital characteristics, the remaining parts are the descriptive analysis of patient characteristics and concentration indices. On average, the total hospital variable costs are N787, 906.50, while the health care price for general medical services is N114, 183 with a standard deviation of N59, 706. Moreover, the total number of hospital patients per week is on average 94. On average, a hospital employs 2 house officers and 4 registered nurses. Doctors in a mixed hospital market spend an average of 19 hours approximately on duty per day with a degree of deviation of 7, while doctors in a private hospital market spend more, while the average number of hospital beds is 21. The average staff-nurse patient ratio is 4.8. In terms of the location of hospitals, 73% of the hospitals are located in the urban area, indicating that few percentages of the hospitals in Ibadan metropolis are located in the rural area. The result of patient characteristics shows that the average health care price paid by patients is 91,683. This is lower than the average actual health care price list of hospitals. Also, the patient's average monthly income on the average is N42, 483.70. Also, patients with post-secondary education on the average has the highest proportion, while patients with no formal education are the least. The proportion of patients without health insurance is higher than those with health insurance coverage. From Table 2, the proportion of high HHI and CR is higher, which implies that the concentration level in the hospital markets is high, thus, concentrated markets characterized the hospital markets in Ibadan. The mean number of competitors across the markets is 8.

Empirical results of the effect of market concentration on health care price and quality

In order to examine the association between hospital market concentration, the quality, and price of health care, the concentration indices obtained from the construction HHI and CR as well as the number of

Table 2. Descriptive statistics results.

Variable	Observation	Mean	Std. Dev.
Hospital Characteristics			
Average var. cost	115	787,906.500	563,815.700
Average Health care price	115	114,183.000	59,706.620
No of Hosp. pat	115	94.017	157.398
Market share of bed	115	0.136	0.114
Log no of full time House officers	115	1.243	2.668
Registered Nurses	115	4.226	4.903
Hospital Beds	115	21.183	18.746
Staff-Nurse, Patient Ratio	115	4.766	3.288
Urban location of hospital	115	0.730	0.446
Rural location of hospital	115	0.270	0.446
Patient Characteristics			
Average health care price paid OOP	689	91,683.38	38,824.14
Average Income	689	42,483.740	30,012.590
No Education	689	0.049	0.217
Pry Education	689	0.110	0.313
Sec Education	689	0.274	0.446
Post-sec Education	689	0.566	0.496
Pat with health insurance	689	0.370	0.483
Pat without health insurance	689	0.630	0.483
Concentration Indices			
Low_HHI	689	0.422	0.494
High_HHI	689	0.578	0.494
Low_CR	689	0.460	0.499
High_CR	689	0.540	0.499
No of Competitors	689	8.244	2.966

Source: Computed from STATA 14, (2020)

Table 3. OLS Results (Effect of Market Concentration on Health Care Price).

Variable	Log of Health care price
Low_HHI	-0.048(-0.83)
Low_CR	-0.1335**(-2.24)
No of Hosp. Com	0.0025(0.2)
Log of Income	0.1783*** (3.44)
No Education	-0.1381(-0.91)
Pry Education	0.0426(-0.47)
Sec Education	0.0026(-0.04)
Log no of Hosp. pat	0.2909*** (5.87)
Pat with health insurance	-0.1674**(-2.57)
Rural location of hospital	0.0283(-0.39)
Market share of bed	0.4292*** (2.63)
Log of average var. cost	0.0082(-0.12)
Constant	8.1364***(-9.14)
Number of observation	676
R-sq	0.131
adj. R-sq	0.12
F Statistics	7.89(0.000)

The t-statistics are presented in parenthesis

Source: Computed from STATA 14, (2020)

competitors were regressed on the price of health care and the quality indicators using Ordinary Least Square (OLS) estimation technique and the results obtained are presented in Table 3. The analysis employed percentile dummies for the HHI and CR, categorized into Low HHI and CR (less concentrated) and High HHI and CR (concentrated market) with High HHI and CR as the base category. Other dummy variables are educated, patient insurance status. The reference categories for the categorical variables were variables with the highest observation and that fall to the extreme side of the

distribution. Control variables were patients and hospital characteristics. The test of significance employed was F statistics. Heteroscedasticity and potential auto-correlation were corrected in the statistical results using robust standard errors. The F-statistics and their probability values show that the independent variables have explanatory and significance power. Also, the pseudo r-squared for most of the models was fairly high (above 25%). The statistical significance was at $p \leq 0.05$.

The results for the effect of market concentration on the health care price show that market concentration drives health care price as a change from high CR to low CR lead to 13.4% decrease in health care, price, indicating that health care price is 13.4% lower in a less concentrated market than in a concentrated market. This result is consistent with the findings that hospital prices decrease significantly as markets are more competitive [38]. Income significantly and positively influences health care prices by 17.8%. Moreover, an increase in the volume of hospital patients also increases the health care price. Also, patients with health insurance make hospitals reduce health care prices more than patients without health care insurance coverage. Market share of hospital beds; an indicator of hospital size also relates positively to health care price. The economic intuitions from the results obtained from the effect of market concentration on the health care price show that a market concentration with a large number of hospitals with a small market share of patients reduces health care prices. The results further show that income, the volume of hospital patients, and hospital size positively influence the hospital's decision on health care, price, while a patient with health insurance coverage status is otherwise.

The results show that the concentration indices were significantly related to quality indicators. Specifically, low HHI lead to 35.2%, 19.1%, 11.8%, and 33.4% increase in the number of full-time house officers, registered nurses, hospital beds, and Staff-nurse-Patient Ratio (SPR) respectively. Also, a change from high CR to low CR leads to 15.7% and 29.3% increase in the number of full-time house officers and SPR respectively. In addition, a percentage increase in the number of competitors induces 4.4%, 6.1%, 3.2%, and 8.5% increase in the number of full-time house officers, registered nurses, hospital beds, and SPR in that order as shown in table 4. The results suggest that the quality of health care is higher in less concentrated markets than in the more concentrated markets as hospitals increases the number of full-time house officers, registered nurses, hospital beds and Staff-nurse Patient Ratio.

Income significantly and positively influences the number of full-time house officers and registered

nurses by 13.6 and 9.7% respectively. This indicated that income is a key determinant of patient access to quality of health care; a higher income patient will possibly patronize hospitals that provide a higher quality of health care. Furthermore, patients with none and primary education make hospitals reduce the number of hospital beds and Staff-nurse Patient Ratio (SPR) more than patient with post-secondary education. These patients patronize hospital lesser than those with post-secondary education, thus, they make hospitals reduce the number of beds and treatment intensity, patients with secondary education make hospitals to increase the number of full-time house officers. Moreover, an increase in the volume of hospital patients makes hospitals employ more full-time house officers, registered nurses, hospital beds and reduce SPR. By implication, an increase in the volume of hospital patients signifies growth, as the number of patients that attend hospitals increases; hospitals also increase their scope of operation to deliver higher quality health care. Hospitals achieve this by increasing the number of house officers on full-time, registered nurses, and hospital beds. However, the heavy inflow of patients often makes hospital staff to be inadequate, as they reduce treatment intensity by assigning a staff nurse to a large number of patients.

Also, patients with health insurance make hospitals reduce the number of registered nurses and hospital beds more than patients without insurance. Hospitals in rural location also reduce the number of full-time house officers by 14.7%, while they respectively increase the number of registered nurses and SPR by 41.3% and 46.3%. In Nigeria, few numbers of hospitals are located in the rural areas and the majority of the medical staff, especially the physicians are rarely found in the rural hospitals. Also, the market share of hospital beds, which indicates hospital size, has a positive and significant relationship with the number of registered nurses and hospital beds. Also, the total average variable cost has a positive and significant relationship with the number of full-time house officers and registered nurses. An increase in the average health care prices significantly increases the quality as hospitals increase the number of registered nurses and SPR by 11.9% and 19.9% individually. Hospitals provide a higher quality of health care when patients pay higher health care prices by means of employing a higher number of registered nurses and increasing treatment intensity by assigning few numbers of patients to a staff nurse.

Conclusion and recommendations

This study examined the market concentration in Ibadan metropolis using the concentration indices.

The findings of the study show that concentrated markets with few numbers hospitals and larger market share of patients characterized the hospital markets in Ibadan. Looking at the effect of market concentration on the health care price and quality, the results indicated that health care price is lower in the less concentrated markets than in the more concentrated markets, while health care quality is higher in the less concentrated markets than in the more concentrated markets. Thus, a less concentrated market is linked with higher health care quality and lower health care prices. The results further that show that income, the volume of hospital patients, and hospital size positively influence the hospital's decision on health care prices, while patient health insurance coverage status has a negative effect on health care price. The results further suggested that patient's income, level of education, and health care price paid by patients significantly motivate hospitals to produce a higher quality of health care. Other hospitals feature such as hospital size; average variable costs and hospital patient volume also induce hospitals to provide higher health care quality.

The findings of this study have policy implications for policymakers in their efforts to ensure patients receive higher quality health care and to reduce higher health care associated with a higher quality of health care. As obtained in this study, less concentrated market, which promotes lower health care price and higher health care quality in the hospital markets and this is welfare enhancing. On this basis, this study recommends policies that will allow entry of more hospitals through high levels of investment in the health sector by the government and private sector so as to reduce market concentration and enhance consumer welfare in terms of price and quality. Also, incentives that will allow expansion and increase the size of hospitals via giving subsidies on equipment purchase and periodic donation of drug supplies and equipment by the government to newly established hospitals will encourage hospitals to offer higher quality health care to patients and curtail health care prices.

Authors' contributions

Bosede Olanike Awoyemi conceived the study and undertook the data collection, performed the data analysis and wrote the manuscript, while the research was carried out under the supervision of Prof Olaniyan. Both authors read and approved the final manuscript.

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Ethical Approval

Ethical clearance with number UI/EC/14/0246 was obtained from the U.I./UCH ethical review Board. In consonance to the ethics of research in assuring the confidentiality of the patients and hospitals, serial numbers and not the names of the hospitals and patients was used. The participants were assured of their right to decline participation in the study. Also, they were required to sign the informed consent (form) after the objectives and procedures of the study had been explained to them. All the consent forms and copies of the questionnaire are to be kept in a secured place for 5 years.

Consent for Publication

The authors give consent for publication of this research work in the Health Economics Review journal if found acceptable.

Availability of data and materials

The datasets used during the current study are available from the corresponding author on request.

Disclosure of potential conflicts of interest

No potential conflict of interest was reported by the author(s).

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