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# Impact of Technological Infrastructure on Quality of Service in the Nigerian Health Sector

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### Authors' contributions

This work was carried out in collaboration between all authors. Author BAO designed the study and wrote the first draft of the manuscript. Authors TOO and TOA managed the analyses of the study as well as the literature searches. Author OSA performed the statistical analysis. All authors read and approved the final manuscript.

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## ABSTRACT

**Background:** This study investigated the level of infrastructure in Nigerian hospitals, assessed the quality of service in the hospitals and examined the impact of infrastructure on quality of service.

**Methods:** Survey method was used. Two sets of questionnaire were administered on patients and workers in primary, secondary and tertiary health care facilities.

**Summary of Results:** There were 207 respondents made up of 92 health workers and 115 patients. Inadequacy of manpower and utilities was generally reported by the health workers. The overall mean for (Doctors, Nurses, Ward aids and Laboratory staffs adequacies) were 1.31, 1.31, 1.49 and 1.21 respectively with laboratory staff as the most inadequate. Also, among the diagnostic facilities, laboratory equipment is very inadequate (mean of 1.06). Perception by patients also shows gross inadequacy of manpower with overall mean of 1.94, 1.88, 1.65 and 1.50 for doctors, nurses, ward aids and laboratory staffs respectively with laboratory staff as the most inadequate similar to the perception by the hospital workers.

Majority (44.3%) of the patients were satisfied with the services rendered by medical doctors and the nurses (50.4%), but a weighted average of 1.82 shows that they were not satisfied with the

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services rendered by the laboratory staff. Similarly, a weighted average of 1.87 shows that patients were not satisfied with the total time taken before medical care was given.

Concerning mode of payment through National Health Insurance Scheme (NHIS), majority (92.2%) were not satisfied due to their non-awareness of the scheme. Most (51.3%) of the patients made payment by self but a weighted average of 1.87 shows general dissatisfaction with it.

Impact of staff/infrastructure inadequacy on quality of service shows statistical significant relationships ( $p < 0.05$ ) with gross mismatch of patients and workers. On regression analysis about impact of infrastructure on the quality of service, the effect is 48% of the total variation in gross mismatch, and  $F$  value is high (7.324) with health workers'  $p$ -value of 0.00. Therefore, there is a significant impact of the infrastructure on the quality of service.

**Conclusion:** The study concludes that there is a need to improve on the quality and quantity of modern health infrastructure provided for Nigerian health care centres.

*Keywords: Nigeria; hospitals; infrastructure; service; quality.*

## 1. INTRODUCTION

The importance of infrastructure to the development of any nation cannot be overemphasized. The development of a society depends on the availability of infrastructure in homes and industries [1]. When infrastructure is inadequate, systems may slow down or halt; and this may constitute threat to human survival. On the other hand, public access to infrastructure generates value for the society [2]; also, open access to infrastructure would generate significantly positive results for the society [1,3].

Deterioration in infrastructure has adversely affected health care delivery in Nigeria [4]. The quantity of investment in the Nigerian health sector has been on the decline over the years [5]. There have been widespread complaints over the deplorable state of infrastructure and unsatisfactory quality of service delivery in different sectors of the economy [5]. Infrastructural decay might also not be unconnected with poor health seeking attitudes of many people. While some patronise spiritual houses for medical care, many others are doing self-medication or patronizing expensive private hospitals where they hope to get adequate infrastructure; and this makes them poorer. This is not surprising as it is well established in the literature that service delivery quality has a significant relationship with customer satisfaction; in case patients or customers perceive functional issues (which they perceive and interact with during the course of seeking treatment such as physical facilities, internal process, interactions with doctors, nurses and other support staff) as poor and unresponsive, they look for an alternative provider and may spread negative word of mouth which may affect

potential clients and hence, growth of the hospital.

The Nigerian health care delivery system operates at four levels; primary, secondary, tertiary and private. The primary health care delivery is the purview of the local governments and this is regulated by the National Primary Health Care Development Agency [5]. Secondary health delivery system comprises the general hospitals which are run by the state governments while the tertiary health institutions i.e. university teaching hospitals and federal medical centres are funded by the Federal government [6,7].

It has been observed [8] that infrastructure development can have great impact on health especially on child and maternal mortality. Access to clean water and sanitation has been noted to contribute significantly to reducing child mortality [9-13]. The above has also been corroborated by other studies [14].

The quantity of investment in the Nigerian health sector (which affects the quantity and quality of infrastructure in the sector) has been on the decline over the years. For example, total expenditure on health care in 2012 was put at 4.6% of GDP, and the percentage of federal expenditure on health was a meagre 1.5% [5]. Maternal mortality ratio, which is currently 560 per 100,000 live births, is still high [15]. As at 2007, there were 13,703 public's primary health care centres, 845 secondary health centres and 59 tertiary health centres which were meant to cater for a population of about 140 million people [5]. Thus, the health care delivery system in Nigeria has performed very poorly [4].

Whereas there have been calls for improvement on health care infrastructure and service delivery in Nigeria, this subject has not attracted the attention of researchers. Local studies done on service quality had focused on banking and public sector in general. There was no known study that had focusing on investigating impact of infrastructure on quality of service in the Nigerian Health sector. This study, therefore, sought to investigate and bridge this gap.

## 2. METHODOLOGY

Survey method was used. Two sets of questionnaire were administered to elicit information on patients' and healthcare workers' perception of the level of infrastructure and the quality of service in selected primary, secondary and tertiary health care facilities. A total of 250 questionnaires were administered in 15 hospitals across two states in Nigeria.

To determine the level of infrastructure in Nigerian hospitals, the adequacy of manpower (doctors; nurses; ward aids and laboratory staff) and diagnostic facilities (X-ray, echocardiography, ECG, ultrasound and laboratory equipment) were examined from both the workers' and patients' perspectives while utilities (water supply, electricity, hospital beds and drugs) were examined only from the workers' perspective because they are the ones that can know in details the adequacy of the utilities they use.

Likert-like rating scales were used to measure the adequacy of infrastructure such as manpower, medical facilities, staff availability, and equipment availability. Customer (patient) satisfaction ratings were used to measure the quality of service. Inferential statistics were used to measure the impact of infrastructure on quality of service delivery.

## 3. RESULTS AND DISCUSSION

In the study, there were 207 respondents made up of 92 health workers and 115 patients Table 1 presents the level of infrastructure in the hospitals as perceived by hospital workers. Inadequacy of manpower was generally reported by them. Inadequacy of utilities was also generally reported by the respondents. Water supply, electricity supply, and hospital beds were inadequate; it is not uncommon to see that patients often remain long at the accident and emergency (A&E) wards because the beds in the

wards have been filled up. Also, there was inadequacy of drugs offered in the hospitals which often results in the alternative solution for patients of purchasing drugs from pharmacies outside the hospital premises due to non-availability or when they consider the ones outside as being cheaper. Though this is not seriously frowned at, it poses grave danger to patients because of adulterated drugs.

Diagnostic facilities were considered generally inadequate by the respondent hospital workers. X-ray equipment, ECG facilities, ultrasound equipment, and laboratory equipment were reported to be inadequate. Diagnostic tests are known to be undertaken outside many hospitals not because they are cheaper outside, but because hospital facilities have become obsolete or because they have broken down.

On a departmental basis, staff availability in most of the survey departments like A&E unit, children emergency unit (CEU) special care baby unit (SCBU), general outpatient department (GOPD), otolaryngology (ear, nose and throat (ENT) department, eye clinic, male/female surgical departments, gynaecology department, male/female medical department, and psychiatric department staff was perceived to be inadequate.

Equipment availability in all the departments was rated generally low by respondents. Table 2 presents the level of infrastructure in the hospitals as perceived by patients. Inadequacy of manpower was also generally reported by them.

Table 3 presents the patients' satisfaction with services rendered by health workers. Majority (44.3%) of the patients were very satisfied with the services rendered by medical doctors, 50.4% of the patients were satisfied with the care services rendered by the nurses, but a weighted average of 1.82 shows that they were not satisfied with the services rendered by the laboratory staff. Similarly, a weighted average of 1.87 shows that patients were not satisfied with the total time taken before medical care was given. Concerning mode of payment through National Health Insurance Scheme (NHIS), majority (92.2%) did not respond possibly due to their non-awareness of the scheme or their aversion to it. Only 3.5% and 1.7% were satisfied and very satisfied with payment through the scheme respectively. However, most of the patients (51.3%) were satisfied with payment by self but a weighted average of 1.87 shows general dissatisfaction with it.

**Table 1. Level of infrastructure in the health sector (Hospital workers' perception)**

| Variables                        |             | VA (%)    | A (%)     | NA (%)    | DN (%)    | M(%)      | Total (%) | WA   |
|----------------------------------|-------------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| Manpower adequacy                | Doctors     | 4 (4.3)   | 25(27.2)  | 55 (59.8) | 5 (5.4)   | 3 (3.3)   | 89 (96.7) | 1.13 |
|                                  | Nurses      | 5 (5.4)   | 19 (20.7) | 62 (67.4) | 2 (2.2)   | 4 (4.3)   | 88 (95.7) | 1.13 |
|                                  | Ward  Aids  | 7 (7.6)   | 30 (32.6) | 50 (54.3) | 1 (1.1)   | 4 (4.3)   | 88 (95.7) | 1.49 |
|                                  | Lab. staffs | 7 (7.6)   | 16 (17.4) | 50 (54.3) | 12 (13.1) | 7 (7.6)   | 85 (92.4) | 1.21 |
| Utility / Facility adequacy      | Water       | 3 (3.3)   | 22 (23.9) | 62 (67.4) | 1 (1.1)   | 4 (4.3)   | 88 (95.7) | 1.31 |
|                                  | Electricity | 5 (5.6)   | 27 (29.3) | 56 (61)   | 0 (0)     | 4 (4.3)   | 88 (95.7) | 1.42 |
|                                  | Beds        | 6 (6.4)   | 34 (37)   | 48 (52.2) | 2 (2.2)   | 2 (2.2)   | 90 (97.8) | 1.49 |
|                                  | Drugs       | 3 (3.3)   | 26 (28.2) | 55 (59.8) | 5 (5.4)   | 3 (3.3)   | 89 (96.7) | 1.30 |
| Diagnostic facility adequacy     | X- Ray      | 5 (5.4)   | 20 (21.7) | 56 (61.0) | 5 (5.4)   | 6 (6.5)   | 86 (93.5) | 1.29 |
|                                  | ECG         | 6 (6.5)   | 17 (18.5) | 57 (62.1) | 6 (6.5)   | 6 (6.5)   | 86 (93.5) | 1.27 |
|                                  | Ultrasound  | 7 (7.6)   | 19 (20.7) | 52 (56.5) | 9 (9.8)   | 5 (5.4)   | 87 (94.6) | 1.28 |
|                                  | Lab. Equip  | 3 (3.3)   | 17 (18.5) | 47 (51.1) | 18 (19.6) | 7 (7.5)   | 85 (92.5) | 1.06 |
| Departmental staffs availability | A&E         | 3 (3.3)   | 15 (16.2) | 68 (73.9) | 3 (3.3)   | 3 (3.3)   | 89 (96.7) | 1.20 |
|                                  | CU          | 2 (2.2)   | 18 (19.6) | 56 (60.9) | 11 (12.0) | 5 (5.3)   | 87 (94.7) | 1.13 |
|                                  | SCBU        | 2 (2.2)   | 16 (17.3) | 56 (60.9) | 15 (16.3) | 3 (3.3)   | 89 (96.7) | 1.06 |
|                                  | GOPD        | 4 (4.3)   | 32 (34.8) | 48 (52.2) | 6 (6.5)   | 2 (2.2)   | 90 (97.8) | 1.38 |
|                                  | ENT         | 3 (3.3)   | 15 (16.3) | 54 (58.7) | 16 (17.4) | 4 (4.3)   | 88 (95.7) | 1.06 |
|                                  | Eye         | 3 (3.3)   | 20 (21.7) | 45 (49.0) | 20 (21.7) | 4 (4.3)   | 88 (95.7) | 1.07 |
|                                  | Surgical    | 2 (2.2)   | 23 (25.0) | 54 (58.7) | 10 (10.8) | 3 (3.3)   | 89 (96.7) | 1.19 |
|                                  | O&G         | 3 (3.3)   | 20 (21.7) | 56 (60.9) | 10 (10.8) | 3 (3.3)   | 89 (96.7) | 1.18 |
|                                  | Medical     | 2 (2.2)   | 21 (22.8) | 53 (57.6) | 13 (14.1) | 3 (3.3)   | 89 (96.7) | 1.13 |
| Psychiatry                       | 2 (2.2)     | 25 (27.2) | 40 (43.5) | 22 (23.8) | 3 (3.3)   | 89 (96.7) | 1.08      |      |

(NB: VA = vary adequate, A = adequate, NA = not adequate, DN = don't know, M = missing WA = weighted average)

**Table 2. Patients' perception of adequacy of infrastructure**

| Variables           |               | VA (%)    | A (%)     | NA (%)    | DN (%)    | M (%)     | Total (%)  | WA   |
|---------------------|---------------|-----------|-----------|-----------|-----------|-----------|------------|------|
| Manpower adequacy   | Doctors       | 34 (29.6) | 40(34.8)  | 30 (26.1) | 5 (4.3)   | 6 (5.2)   | 109 (94.8) | 1.94 |
|                     | Nurses        | 27 (23.5) | 47 (40.9) | 26 (22.6) | 7 (6.0)   | 8 (7.0)   | 107 (93.0) | 1.88 |
|                     | Ward  Aids    | 19 (16.5) | 46 (40.9) | 21 (18.3) | 17 (14.8) | 12 (10.4) | 103 (89.6) | 1.65 |
|                     | Lab. staffs   | 15 (13.0) | 40 (34.8) | 27 (23.5) | 19 (16.5) | 14 (12.2) | 101 (87.8) | 1.65 |
| Diagnostic Facility | X-Ray         | 18 (15.7) | 31 (27.0) | 13 (11.2) | 35 (30.4) | 18 (15.7) | 97 (84.3)  | 1.33 |
|                     | ECG           | 8 (7.0)   | 18 (15.7) | 15 (13.0) | 47 (40.8) | 27 (23.5) | 88 (76.5)  | 0.85 |
| Adequacy            | USS           | 11 (9.6)  | 18 (15.7) | 15 (13.0) | 45 (39.1) | 26 (22.6) | 89 (77.4)  | 0.94 |
|                     | Lab Equipment | 10 (8.7)  | 35 (30.4) | 20 (17.4) | 27 (23.5) | 23 (20.0) | 92 (80.0)  | 1.30 |

NB: VA = vary adequate, A = adequate, NA = not adequate, DN = don't know, M = missing WA = weighted average

**Table 3. Patients' satisfaction with health services**

| Staff care / Facility availability | Level of satisfaction |           |           |           |            |            | Total (%) | WA |
|------------------------------------|-----------------------|-----------|-----------|-----------|------------|------------|-----------|----|
|                                    | VS (%)                | S (%)     | NS (%)    | DN (%)    | M (%)      |            |           |    |
| Doctors' care                      | 51 (44.3)             | 50 (43.5) | 7 (6.3)   | 1 (0.9)   | 6 (5.2)    | 109 (94.8) | 2.39      |    |
| Nurses' care                       | 41 (35.7)             | 58 (50.4) | 7 (6.1)   | 0 (0)     | 9 (7.8)    | 106 (92.2) | 2.32      |    |
| Laboratory staff care              | 24 (20.9)             | 47 (40.8) | 14 (12.2) | 14 (12.2) | 16 (13.9)  | 99 (86.1)  | 1.82      |    |
| Total time b4 care                 | 29 (25.2)             | 40 (34.8) | 37 (32.2) | 3 (2.6)   | 6 (5.2)    | 109 (94.8) | 1.87      |    |
| NHIS payment                       | 2 (1.7)               | 4 (3.5)   | 3 (2.6)   | 0 (0)     | 106 (92.2) | 9 (7.8)    | 1.89      |    |
| Self payment                       | 12 (10.4)             | 59 (51.3) | 17 (14.8) | 6 (5.2)   | 21 (18.3)  | 94 (81.7)  | 1.82      |    |
| Other payment sources              | 4 (3.5)               | 2 (1.7)   | 1 (0.9)   | 1 (0.9)   | 107 (93.0) | 8 (7.0)    | 2.12      |    |

NB: VS = very satisfied, S = satisfied, NS = not satisfied, DN = don't know, M = missing, WA = weighted average.

From the workers' perspective, following the overall mean in Table 1, it was found that the overall mean for manpower adequacy in terms of doctors' adequacy, nurses' adequacy, ward aids' adequacy and laboratory staff adequacy were 1.31, 1.31, 1.49 and 1.21 respectively which shows that it was the laboratory staff that were the most inadequate followed by doctors/nurses and then the ward aids. Also, among the diagnostic facilities from the same table, laboratory equipment is very inadequate (mean of 1.06) followed by ECG (1.27), Ultrasound (1.28) and X-ray (1.29) respectively. Laboratory staff and equipment might be the most inadequate because of Nigeria's high population which calls for training and engagement of more laboratory staff. Moreover, among the utilities, drug is very inadequate (mean of 1.30) followed by water supply (1.31), electricity (1.42) and hospital beds (1.49) respectively which might be because of the same reason of high and increasing population.

Likewise, from the patients' perspective, the overall mean as presented in Table 2, it was found that the overall mean for manpower adequacy in terms of doctors' adequacy, nurses' adequacy, ward aids' adequacy and laboratory staff adequacy were 1.94, 1.88, 1.65 and 1.50 respectively which shows that it was the laboratory staff that was the most inadequate (as also perceived by the workers), followed by ward aids and nurses and then the doctors, this also is similar to the perception of the workers). Also, among the diagnostic facilities obvious from the same table, ECG is very inadequate (mean of 0.85) followed by Ultrasound (0.94), laboratory equipment (1.30) and X-ray (1.33) respectively. This might be due to the poor funding of Nigerian hospitals generally which then leads to inadequacy of the needed infrastructure. Therefore, the level of infrastructure in Nigerian hospitals could be said to be generally inadequate, for none of the mean values of all the infrastructure is up to 2.0. Poor infrastructural development is the bane of many developing countries, and this has brought about the attendant result of low productivity.

The quality of service was measured in terms of satisfaction and viewed only from the patients' perspective because they were the consumers of the services. This involves their satisfaction with the services rendered by the doctors, nurses and the laboratory staff of the hospitals. Findings showed that most (87.8%) of the patients were satisfied with doctors' care (both very satisfied

44.3%, and satisfied 43.5%), and the minority (6.1%) were not satisfied, which shows patients were receiving good quality health care from doctors as confirmed by the average mean value of 2.39. This might be because Nigerian hospitals ensure that they engage qualified doctors because they are the determinants of the level of patronage the hospitals will get.

Similarly, the majority of the patients (86.1%) were satisfied with nurses' care which shows they are also receiving good quality health care from them as confirmed by the average mean value of 2.32 for nurses. This might also be because of the importance attached to the engagement of qualified nurses by Nigerian government hospitals. Therefore, the quality of service in the hospitals was quite good except in the unsatisfactory service of the laboratory staff; as well as the equipment inadequacy which need improvement. The inadequacy might be attributed to very high population of the country and poor funding of Nigerian hospitals.

To examine the impact of infrastructure on quality of service, the effect of staff inadequacy, non-availability of equipment and large patient population on the performance of workers was examined. Among workers, this was first achieved by running a correlation analysis on the relationship between gross mismatch of patients and health workers population wise and each of the mentioned variables (staff inadequacy, non-availability of equipment and large patient population) as shown in Table 4. From the table, it is obvious that staff inadequacy and equipment availability effects have significant relationships ( $p < 0.05$ ) with gross mismatch of patients and workers and there is a direct relationship between them in that as the effects are higher, there will be more gross mismatch of patients with workers. Large patient population effect might not be significant because if staff and equipment are adequate, it will cater for the patients, no matter their population. Therefore, staff inadequacy and equipment non-availability have negative impact on quality of service of the workers. Moreover, among workers, regression analysis was done to analyze the impact of infrastructure on the quality of service as shown in Table 5a and b.

From Table 5a, the effect is 48% of the total variation in gross mismatch, and  $F$  value is high (7.324) which shows that the variables included are worthy of inclusion as indicated by the  $p$ -value of 0.00, which is very significant ( $p < 0.05$ ).

**Table 4. Relationship between gross mismatch of patients and workers and staff inadequacy, non-availability of equipment and large patient population in the Nigerian hospitals**

|                                      | Staff inadequacy effect | Non availability of equipment effect | Large patient population effect |
|--------------------------------------|-------------------------|--------------------------------------|---------------------------------|
| Gross mismatch of patients & workers | 322**                   | 254**                                | 284*                            |
| Pearson Correlation                  | 003                     | 004                                  | 012                             |
| N                                    | 83                      | 79                                   | 77                              |

\*\* Correlation is significant at the 0.01 level (2-tailed)

\* Correlation is significant at the 0.05 level (2-tailed)

**Table 5. Regression analysis showing Impact of infrastructure on the quality of service among Nigerian health workers**

(a).

| Model | R                 | R Square | Adjusted R Square | Std. Error of the estimate |
|-------|-------------------|----------|-------------------|----------------------------|
| 1     | .481 <sup>a</sup> | .231     | .200              | .689                       |

a. Predictors (Constant), Large patient Population Effect, Staff inadequacy Effect, Equipment Non-Availability Effect.

(b).

| Model |            | Sum of squares | Df | Mean square | F     | Sig.  |
|-------|------------|----------------|----|-------------|-------|-------|
| 1     | Regression | 10.432         | 3  | 3.477       | 7.324 | 0.000 |
|       | Residual   | 34.654         | 73 | .475        |       |       |
|       | Total      | 45.091         | 76 |             |       |       |

a. Predictors (Constant), Large patient Population Effect, Staff inadequacy Effect, Equipment Non-Availability Effect.

b. Dependent Variable: Gross mismatch of patients and workers

Therefore, there is a significant impact of the mentioned infrastructure (staff inadequacy, non-availability of equipment and large patient population) on the quality of health workers' service.

#### 4. CONCLUSIONS

In conclusion, the study finds inadequacies in the provision of manpower, medical facilities and equipment. In spite of this, majority of the patients indicated satisfaction with the performance of the health workers especially doctors and nurses. Thus, the level of patients' satisfaction is expected to increase if medical facilities and equipment become more readily available. There was a significant ( $p < 0.05$ ) relationship between the infrastructural inadequacies and the quality of health workers' service. There is an urgent need for improvement in human infrastructure (manpower) of Nigerian hospitals. Also, infrastructure in terms of utilities and adequate, modern diagnostic equipment need to be provided to aid medical investigations.

#### 5. POLICY RECOMMENDATIONS

- i. Infrastructures in terms of utilities and adequate, modern diagnostic equipment need to be provided to aid medical investigations.
- ii. It is not enough to have facilities and equipment, but the requisite trained technical manpower is also important to keep the equipment in good working conditions.
- iii. It is equally imperative for government to invest more in the health sector in terms of resources. A healthy nation will most likely be a productive nation, whereas the reverse is not plausible. Aside from this, provision of good health infrastructure should be seen as public good, which indeed is part of the role of government.
- iv. Non-government organizations such as social, religious etc and could also support government in improving health infrastructure. This can be done through donations of medical equipment and related items. This would go a long way in

reducing the burden of provision of infrastructure by government.

## CONSENT

As per international standard or university standard written patient consent has been collected and preserved by the authors.

## ETHICAL APPROVAL

As per international standard or university standard written ethical permission has been collected and preserved by the authors.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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