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Assessment of the Distribution of Healthcare Personnel in the Northern Senatorial Zone of Adamawa State, Nigeria

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ABSTRACT

Improving maternal health outcomes requires the availability of skilled birth attendants, including midwives, nurses, and physicians, distributed equitably across geographic areas. Nigeria possesses one of the largest health workforces on the African continent, yet this workforce remains insufficient to meet the country's health needs, particularly in underserved rural and conflict-affected areas. This study assesses the spatial distribution of healthcare personnel across the five Local Government Areas (LGAs) of the Northern Senatorial Zone of Adamawa State, namely Madagali, Mubi North, Mubi South, Michika, and Maiha. The zone comprises a total of 270 health centres, from which 70 were selected using the Krejcie and Morgan (1970) proportional sampling formula. Primary data were collected through GPS-coordinated field surveys, structured questionnaires, and purposive interviews administered to 397 health personnel. Data were analyzed using descriptive statistics and results presented in tabular and cartographic form. The findings reveal a critical shortage of qualified healthcare workers across the study area, with only six doctors recorded for the entire zone. While community health extension workers constitute the majority of the health workforce, there is marked inequality in the distribution of skilled personnel — particularly nurses, midwives, and physicians — across the five LGAs. The study recommends that the state government prioritize targeted recruitment and deployment of skilled personnel to rural health centers, invest in training and capacity building, and implement structured retention strategies to sustain healthcare delivery in the zone.

Introduction

Maternal mortality remains a major public health challenge in sub-Saharan Africa. According to the World Health Organization (WHO, UNICEF, and UNFPA, 2004), approximately 500,000 women die annually from pregnancy- and childbirth-related complications worldwide, with an additional 8 million suffering from related illnesses and disabilities. Women in Africa face a lifetime risk of one in twenty of dying from causes linked to pregnancy, a burden far exceeding that found in high-income countries.

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A substantial proportion of these deaths are preventable. Khan et al. (2006) identified haemorrhage, sepsis, hypertensive disorders, HIV/AIDS, and complications in the postpartum period as the leading causes of maternal mortality and morbidity across Africa. With access to appropriate, skilled, and affordable care — encompassing doctors, nurses, midwives, and other frontline workers — millions of lives could be saved each year. The provision of such care depends critically on the adequate supply and equitable distribution of health personnel across regions.

Fauveau et al. (1999) demonstrated that the deployment of trained midwives at the village level could significantly improve maternal survival, provided that adequate supervision, resources, and referral systems are in place. This finding underscores the importance not merely of having health personnel in a country but of ensuring that they are distributed where they are most needed.

In Nigeria, the shortage of health professionals is well documented. Ogirima, then President of the Nigerian Medical Association (2018), reported a doctor-to-population ratio of 1:6,000, while Elijah noted ratios of 1:12,000 for pharmacists and 1:1,066 for nurses and midwives combined. More recent estimates from the WHO (2023) place Nigeria's ratio at approximately 1:8,000, against the WHO's recommendation of 1:600. Nigeria currently requires approximately 300,000 additional doctors simply to meet minimum global standards, with a projected timeline of at least ten years to bridge this gap.

Eriki et al. (2015) documented Nigeria's health workforce inventory for 2004 as comprising 39,210 doctors (0.3 per 1,000 population), 124,629 nurses (1.03 per 1,000), 88,796 midwives (0.67 per 1,000), 2,482 dentists (0.02 per 1,000), and 12,072 pharmacists (0.05 per 1,000) — all below the WHO's minimum recommended thresholds. Despite Nigeria holding one of the largest absolute health workforce stocks in Africa, the country's capacity to respond to its population's health needs, particularly in maternal and child health, remains critically constrained.

The WHO, the International Confederation of Midwives (ICM), and the International Federation of Gynaecology and Obstetrics (FIGO) define a midwife as a qualified professional who has completed a recognised midwifery educational programme and is licensed to practice. Such a practitioner is competent to provide supervision and care during pregnancy, labour, and the postpartum period; to conduct deliveries independently; and to care for newborns and infants. The role extends to preventive care, detection of complications, emergency response, and health education for mothers, families, and communities — including antenatal preparation, family planning, and gynaecological services (Sherratt, 2000). This breadth of function makes midwives central to any effective maternal and child healthcare system.

The Northern Senatorial Zone of Adamawa State, located in northeastern Nigeria, comprises a diverse health workforce including doctors, nurses, midwives, Community Health Extension Workers (CHEWs), Junior Community Health Extension Workers (JCHEWs), laboratory scientists, pharmacists, and allied health professionals. Its healthcare infrastructure spans public hospitals, private clinics, and primary healthcare centres (PHCs). However, the zone faces persistent challenges relating to workforce shortages, inadequate infrastructure, and disrupted service delivery, compounded by the security crisis associated with the Boko Haram insurgency (Bashir, 2023).

The doctor-to-patient ratio in the study area is far below the WHO-recommended standard of

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1:600, with some estimates approaching 1:10,000 or worse. Healthcare personnel are disproportionately concentrated in urban centres such as Mubi, while remote and conflict-affected communities depend almost entirely on community health workers and traditional birth attendants (TBAs) who often lack formal clinical training. Many primary healthcare centres are staffed only by CHEWs, creating significant gaps in skilled maternal and child care (Anjorin et al., 2021).

The principal challenges confronting the health system in the Northern Senatorial Zone include inadequate staffing, poor remuneration, scarcity of medical equipment and essential supplies, security threats, and generally unfavourable working conditions — all of which contribute to high rates of attrition and reluctance among qualified professionals to accept postings in the area.

Materials and Methods

Study Area

The Northern Senatorial Zone of Adamawa State (Figure 1) comprises five Local Government Areas: Madagali, Mubi North, Mubi South, Michika, and Maiha. The zone occupies a strategically important position within Adamawa State, sharing an international border with Cameroon to the east and serving as a key commercial and social corridor for the northeastern subregion. (Figure 1.1).

The geography of the zone is diverse, encompassing mountainous terrain, valleys, and floodplains. While this physical diversity presents opportunities for agricultural and economic activity, it also creates significant barriers to the establishment and maintenance of healthcare infrastructure. Difficult terrain and poorly maintained road networks restrict access to health facilities, particularly during the rainy season when many routes become impassable.

The region has been severely affected by insurgent activities, particularly those associated with Boko Haram. This ongoing insecurity has resulted in the destruction of public infrastructure — including health facilities — widespread population displacement, and the evacuation of healthcare workers from frontline areas. These combined effects have profoundly disrupted healthcare delivery in the zone, with maternal and child health services among the most affected (Zirra et al., 2024).

Figure 1: Spatial distribution of health centres in the Northern Senatorial Zone

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Materials and Methods

Data Sources and Sampling Procedure

The study drew on both primary and secondary data sources. Primary data were collected through fieldwork involving GPS-coordinated surveys to capture the geographic coordinates of health centres, structured questionnaires administered to health personnel, and purposive interviews with key health sector informants. Secondary data were obtained from the Adamawa State Primary Health Care Development Agency (ASPHCDA).

To determine the questionnaire sample size, the Taro Yamane (1967) formula was applied:

$$n = N / [1 + N(e)^2] \quad (1)$$

Where: N = population size; e = margin of error (0.05); and 1 = constant.
With N = 15,810 (total health personnel in the study area) and e = 0.05, the formula yielded a sample size of approximately 397. A total of 397 questionnaires were accordingly administered using a convenience sampling approach and subsequently subjected to descriptive statistical analysis.

For the selection of health centres, the Krejcie and Morgan (1970) table of sample sizes was applied to the total population of 270 health centres across the five LGAs, resulting in a sample of 70 facilities. These 70 health centres were then subjected to systematic sampling to ensure proportional representation across the zone.

The formula used in this stage was:

$$n = [\chi^2 \cdot N \cdot P(1-P)] / [e^2(N-1) + \chi^2 \cdot P(1-P)] \quad (2)$$

Where: N = population size; χ^2 = chi-square table value; e = margin of error (0.05); P = population proportion; and degrees of freedom = 1.

Results and Discussion

Table 1 presents the distribution of health centres across the five LGAs of the Northern Senatorial Zone.

Table 1: Distribution of Health Centers by Local Government Area

Local Government Area	Number of Health Centres
Madagali	55
Michika	78
Mubi North	43
Mubi South	48
Maiha	50
Total	**270**

Source: Adamawa State Primary Health Care Development Agency (ASPHCDA), 2023.

As shown in Table 1.1, the zone contains a total of 270 health facilities. Of these, two are general hospitals and two are cottage hospitals, while the remainder are primary healthcare centres and private clinics. The uneven distribution of facilities — with Michika recording the highest count (78) and Mubi North the lowest (43) — reflects broader disparities in population density, resource allocation, and the impact of insecurity on facility construction and maintenance. Table 2 presents the distribution of healthcare personnel by cadre across the five LGAs.

Table 2: Distribution of Healthcare Personnel by Cadre and Local Government Area

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Category	Mubi North	Michika	Maiha	Madagali	Mubi South	Total
Doctors	0	0	3	2	1	6
Nurses	11	11	10	6	3	41
JCHEWs	35	39	23	30	49	176
CHEWs	82	46	35	52	43	258
Attendants	50	58	36	113	43	300
Cleaners	42	15	27	39	44	167

Source: Field Survey, 2023.

Table 3 presents the same personnel data as a proportion of the total workforce within each LGA, offering a more nuanced picture of the relative staffing profile across the zone.

Table 3: Work Status and Proportional Distribution of Healthcare Personnel by LGA

Category	Mubi North	Michika	Maiha	Madagali	Mubi South	Total
Doctors	0 (0.00%)	0 (0.00%)	3 (3.06%)	2 (1.55%)	1 (0.71%)	6 (0.87%)
Nurses	11 (6.47%)	11 (9.91%)	10 (10.20%)	6 (4.65%)	3 (2.14%)	41 (5.94%)
JCHEWs	35 (20.59%)	39 (35.14%)	23 (23.47%)	30 (23.26%)	49 (35.00%)	176 (25.51%)
CHEWs	82 (48.24%)	46 (41.44%)	35 (35.71%)	52 (40.31%)	43 (30.71%)	258 (37.39%)
Attendants	50 (29.41%)	58 (52.25%)	36 (36.73%)	113 (87.60%)	43 (30.71%)	300 (43.48%)
Cleaners	42 (24.71%)	15 (13.51%)	27 (27.55%)	39 (30.23%)	44 (31.43%)	167 (24.20%)
Total	**170**	**111**	**98**	**129**	**140**	**690**

Source: Field Survey, 2023.

Distribution of Doctors

The data in Tables 1.2 and 1.3 reveal a critically low medical doctor presence across the entire Northern Senatorial Zone: only six doctors were recorded for all five LGAs combined, constituting just 0.87% of the total health workforce. Two LGAs — Mubi North and Michika — have no doctors whatsoever, leaving their residents without any direct access to physician-led medical care. Maiha records the highest number with three doctors (3.06%), followed by Madagali with two (1.55%), and Mubi South with one (0.71%).

This level of physician scarcity is deeply concerning for maternal and child health outcomes. Doctors are indispensable for managing complex obstetric complications, including emergency Caesarean sections, haemorrhage control, and the clinical management of high-risk pregnancies. Their near-absence across the zone (Figure 2) substantially increases the risk of delayed or absent medical intervention, with direct implications for maternal and neonatal mortality. This pattern is consistent with findings from comparable settings in rural Nigeria, where low physician density has been significantly associated with elevated maternal mortality rates (Villatoro et al., 2020).

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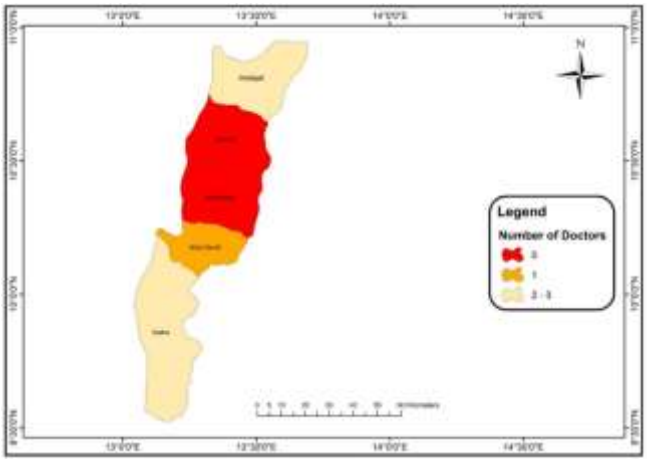

Figure 2: Spatial Distribution of Doctors in Northern Zone

Distribution of Nurses

Forty-one nurses are distributed across the five LGAs, constituting 5.94% of the total workforce. Maiha records the highest nurse-to-total-staff proportion (10.20%), closely followed by Michika (9.91%) and Mubi North (6.47%). Mubi South has the lowest number of nurses in the zone at three (2.14%), followed by Madagali with six (4.65%).

Even the LGAs with relatively higher nurse proportions remain well below what would be required to meet WHO-recommended nurse-to-patient standards. The WHO (2018) identifies nurse-to-patient ratios as a fundamental determinant of care quality, and the overall zone-wide figure of 5.94% clearly indicates that nursing capacity is stretched far beyond effective service delivery thresholds. In areas such as Mubi South and Madagali, excessive workloads, burnout, and reduced quality of care are predictable consequences of such understaffing, and are likely further exacerbated by the security situation, which discourages qualified nurses from remaining in or accepting postings to the area.(Figure 3)

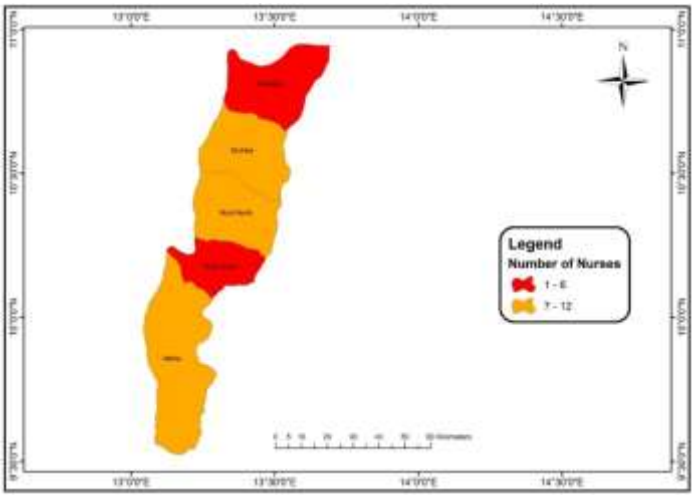

Figure 3: Spatial distribution of Nurses in the Northern Zone

Distribution of Junior Community Health Extension Workers (JCHEWs)

Junior Community Health Extension Workers (JCHEWs) number 176 across the zone, representing 25.51% of the total workforce — a significant share, reflecting the extent to which primary healthcare delivery in this zone depends on lower-cadre community workers.

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Mubi South records the highest concentration (49; 35.00%), followed by Michika (39; 35.14%), while Maiha (23; 23.47%) and Madagali (30; 23.26%) have the fewest.

JCHEWs play a vital role in rural health delivery, as seen in figure 1.4, particularly in areas beyond the reach of doctors and nurses. Their functions include basic maternal and child health education, immunisation drives, and first-line care. Awofeso (2013) found that the presence of JCHEWs in underserved communities measurably improves access to basic health services and maternal health education. While the relatively higher concentration of JCHEWs in Michika and Mubi South is a positive indicator of community-level health coverage, the overall dependence on this cadre also signals a structural weakness in the zone's capacity to manage complex clinical cases.

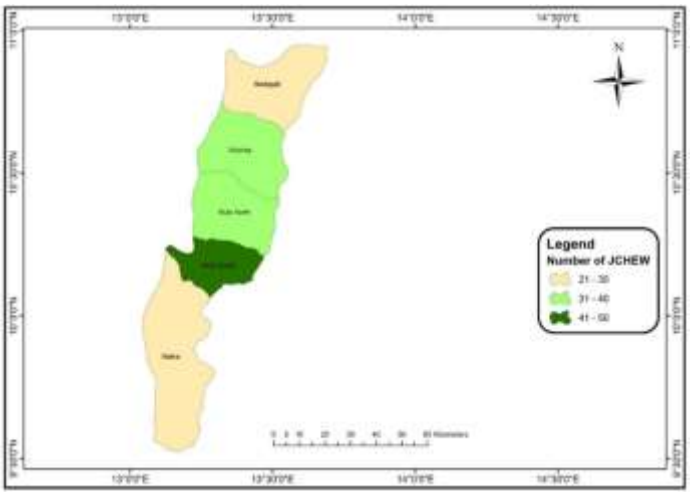

Figure 4: Distribution of JCHEW in Northern Zone

Distribution of Community Health Extension Workers (CHEWs),

Community Health Extension Workers (CHEWs), responsible for delivering primary health services including antenatal care, child immunisations, and maternal health referrals, constitute the largest single professional cadre in the zone at 258 workers (37.39%). Mubi North accounts for the highest number (82; 48.24%), while Mubi South has the fewest (43; 30.71%). The distribution across the five LGAs is comparatively more even than that of doctors or nurses.(Figure 5).

The concentration of CHEWs in Mubi North is broadly positive, given the documented role of this cadre in improving antenatal care uptake and facilitating timely hospital referrals (Iliyasu et al., 2021). Nevertheless, the wide variation in CHEW deployment across the zone — from a high of 48.24% of LGA staff in Mubi North to a low of 30.71% in Mubi South — suggests that the geographic allocation of community health workers has not been consistently planned or implemented.

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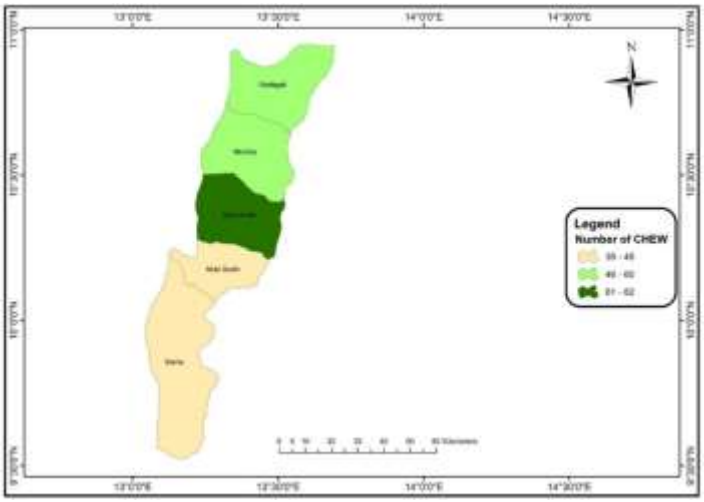

Figure 5: Spatial Distribution of CHEW in Northern Zone

Distribution of Attendants

A total of 300 attendants were recorded across the zone, as seen in Figure 6, representing 43.48% of the total workforce — the single largest occupational category. Madagali records a disproportionately high attendant concentration (113; 87.60% of LGA total), which stands in stark contrast to the very low numbers of clinical staff in that LGA. Maiha has the fewest attendants (36; 36.73%). The dominance of support and auxiliary staff over clinically trained personnel is a structural indicator of workforce imbalance that warrants urgent policy attention.

A healthcare system in which attendants outnumber doctors, nurses, and midwives combined cannot adequately deliver skilled maternal and child health services. While attendants contribute to the smooth running of health facilities, their presence cannot substitute for the clinical expertise necessary for safe delivery and obstetric emergency management.

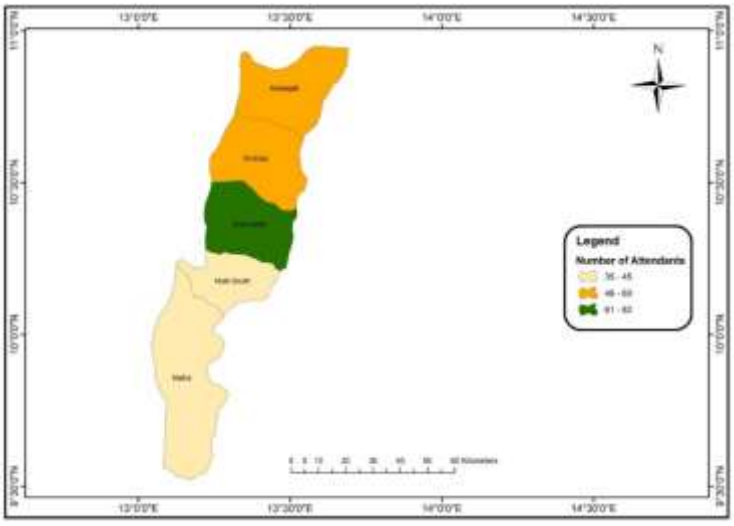

Figure 6: Spatial Distribution of Attendants in Northern Zone

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Distribution of Cleaners

Cleaners number 167 across the zone, accounting for 24.20% of the workforce. (Figure 7) Mubi South has the highest number (44; 31.43%), followed by Madagali (39; 30.23%), while Michika has the lowest (15; 13.51%). While cleaners are essential to maintaining hygienic conditions in health facilities, the pattern observed in Madagali and Mubi South — where they constitute a relatively large share of total staff — may partly reflect the outmigration of skilled staff due to insecurity. Nkemdirim et al. (2020) demonstrated that adequate sanitation in maternal healthcare settings is directly associated with reduced infection rates and improved patient outcomes.

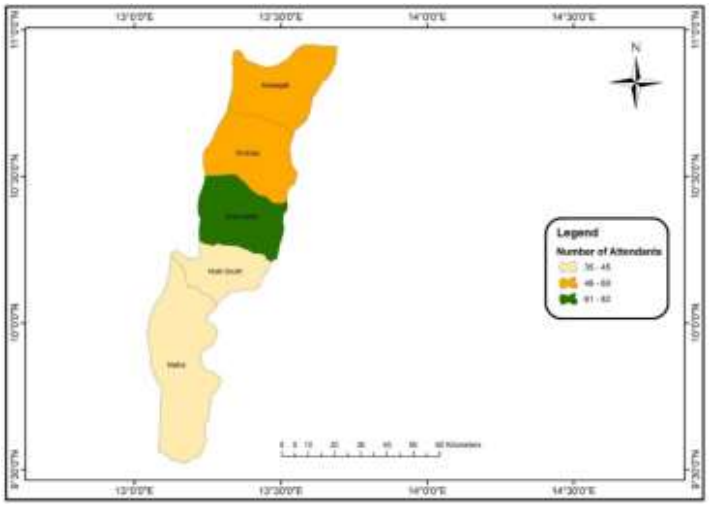

Figure 7: Spatial Distribution of Attendants in Northern Zone

Broader Workforce Context

The overall workforce profile emerging from this analysis reflects a pattern common to many underserved, conflict-affected areas in Nigeria: a large proportion of lower-cadre and auxiliary workers relative to clinically trained staff, with doctors representing less than 1% of the health workforce. Across the three senatorial zones of Adamawa State, this study confirms that JCHEWs and CHEWs form the structural backbone of healthcare delivery, supplemented by pharmacists, laboratory scientists, laboratory attendants, and administrative staff.

Urban centres such as Mubi continue to attract a disproportionate share of qualified personnel due to better working conditions, infrastructure, and career advancement opportunities. The tendency of skilled professionals to concentrate in urban areas at the expense of rural communities is a well-documented challenge in sub-Saharan Africa and one that requires deliberate policy intervention rather than market-driven staffing patterns (Anjorin et al., 2022).

Nigeria's broader health workforce crisis reinforces these findings. As of 2022, the country's doctor-to-population ratio stood at approximately 1:10,000, against the WHO's recommended 1:600, and the nurse ratio at 1:1,160 against a global standard of 1:5 (WHO, 2024). Only seven African countries met the WHO threshold of 10 doctors per 10,000 population in 2022: Cape Verde, Seychelles, Libya, Eswatini, Tunisia, Mauritius, and Algeria. Nigeria remains far from this benchmark, and the Northern Senatorial Zone of Adamawa State presents a profile considerably worse than the national average.

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In the context of maternal care, nurses and midwives bear primary clinical responsibility for antenatal, intrapartum, and postnatal care. Their shortage in this zone, combined with the near-total absence of doctors, creates a system in which the majority of deliveries are managed by personnel whose training may not equip them to handle obstetric complications, with potentially fatal consequences for mothers and neonates.

Challenges in Healthcare Distribution

The distribution of health centres and personnel across the Northern Senatorial Zone is shaped by a complex interplay of geographical, economic, and security-related factors. The ongoing insurgency has had a devastating impact on healthcare infrastructure, resulting in the destruction of facilities, the forced displacement of health workers, and severe disruption to service delivery (Ahmad, 2022). Even in health centres that remain operational, persistent challenges include overcrowding, chronic shortages of essential medicines and medical supplies, and acute understaffing.

Geographical barriers compound these difficulties. The zone's mountainous terrain and poorly maintained road networks restrict access to healthcare, particularly for communities in remote or highland areas. During the rainy season, flooding renders many roads impassable, isolating communities for extended periods and effectively denying residents access to even the most basic health services, including antenatal care.

Economic constraints further undermine health system functioning. Inadequate government investment in rural health infrastructure has produced and sustained stark disparities between urban and rural health service capacity. Health centres in rural areas are chronically underfunded, frequently lacking basic diagnostic equipment, essential medications, and qualified clinical staff. Government initiatives to strengthen primary healthcare — including the establishment of PHCs across the zone — have not been consistently backed by the staffing and resource commitments necessary to make them effective, leaving large segments of the population effectively unserved.

Conclusion

The Northern Senatorial Zone of Adamawa State faces a profound and multi-dimensional healthcare crisis shaped by the intersection of geographic remoteness, socioeconomic marginalisation, security instability, and chronic public sector underinvestment. The findings of this study demonstrate that the zone's health workforce is not only severely understaffed but also structurally unbalanced, with the overwhelming majority of personnel drawn from community health extension categories rather than from the qualified clinical cadres — doctors, nurses, and midwives — that are essential for maternal and child health outcomes.

Urban centres like Mubi retain relatively better-resourced facilities, but the rural majority of the zone's population contends with health centres that are staffed largely by CHEWs and JCHEWs without physician oversight. With only six doctors recorded across five LGAs, and with two of those LGAs having no physician at all, the gap between existing provision and the WHO's minimum standards is striking.

Addressing these challenges will require a coordinated and sustained response: rehabilitation and equipping of health infrastructure, targeted recruitment and deployment of skilled personnel to rural and underserved areas, and meaningful engagement with the security challenges that continue to drive attrition. The long-term health of the zone's population — and particularly its most vulnerable members, pregnant women and children — depends on

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the political will and institutional capacity to translate policy commitments into equitable service delivery on the ground.

Recommendations

On the basis of the findings of this study, the following recommendations are made:

Government at all levels should prioritise the rehabilitation and upgrading of health facilities in rural and underserved areas of the zone, ensuring that primary healthcare centres are adequately equipped and staffed with qualified clinical personnel.

The Adamawa State Government should invest in a structured programme for the training of healthcare personnel, with particular emphasis on increasing the number of doctors, nurses, and midwives available for deployment in the Northern Senatorial Zone.

Effective retention strategies should be designed and implemented to sustain qualified staff in rural postings. These strategies should include competitive and promptly paid allowances for rural service, provision of decent accommodation, and clearly defined career progression pathways.

Regular capacity-building activities — including skills workshops, refresher training, and scholarship schemes — should be established for existing health personnel to improve the quality of service delivery within current workforce constraints.

The security environment must be addressed as a prerequisite for sustainable health system strengthening. Without improved safety conditions, efforts to deploy and retain skilled personnel in affected LGAs will remain difficult to sustain.

Public-private partnerships should be actively pursued to supplement government-funded health services, particularly in areas where public facilities remain non-functional due to damage or displacement.

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