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Diabetes–hypertension multimorbidity and admission hypoxaemia marked every in-hospital COVID-19 death during the Delta wave in a Lagos isolation unit: a retrospective case series

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Research Article

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Ethics Statement: This study was reviewed and approved by the Health Research Ethics Committee (HREC) of the Federal Medical Centre, Ebute Metta, Lagos, Nigeria. The study was conducted in accordance with the National Code of Health Research Ethics (NCHRE) in Nigeria and the ethical principles of the Declaration of Helsinki.

Diabetes–hypertension multimorbidity and admission hypoxaemia marked every in-hospital COVID-19 death during the Delta wave in a Lagos isolation unit: a retrospective case series

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Abstract

Background: Patient-level clinical data from sub-Saharan Africa on hospitalised COVID-19 during the Delta-driven third wave are limited. We describe the characteristics, management and outcomes of consecutive patients admitted to a dedicated COVID-19 isolation unit in Lagos, Nigeria, and identify bedside features associated with in-hospital death.

Methods: Retrospective case series of all consecutive patients admitted to the COVID-19 isolation unit of the Federal Medical Centre, Ebute-Metta, Lagos, between 1 August and 30 September 2021. Infection was confirmed by rapid antigen testing and RT-PCR. Admission demographics, comorbidities, room-air oxygen saturation (SpO_2), full blood count, in-hospital interventions and outcome were abstracted from the unit register. Survivors and non-survivors were compared using exact tests.

Results: Fifteen patients were included (median age 57 years, range 16–81; 10 male); nine had at least one comorbidity. In-hospital mortality was 26.7% (4/15; 95% CI 7.8–55.1). All four deaths occurred in patients with coexisting diabetes and hypertension (4/4 vs 0/11 without this combination; $p = 0.001$), all of whom were hypoxaemic on admission (SpO_2 84–89%). Mortality was 80% (4/5) among patients with admission SpO_2 <90% and 0% (0/10) among those with SpO_2 ≥90% ($p = 0.004$). Non-survivors had a lower lymphocyte fraction (median 8.6% vs 27.3%; $p = 0.040$) and a higher neutrophil-to-lymphocyte ratio (10.8 vs 2.4; $p = 0.056$). Dexamethasone, ivermectin and vitamin supplements were each given to 11 of 14 patients with treatment data.

Conclusions: In this small series, every in-hospital COVID-19 death occurred in patients who presented with diabetes–hypertension multimorbidity and hypoxaemia. Pulse oximetry and a full blood count at admission may help identify a high-risk phenotype for early escalation in resource-limited settings. The frequent use of therapies without proven benefit underlines the need for evidence-aligned prescribing in future epidemic responses. These hypothesis-generating findings require confirmation in larger, multicentre cohorts.

Keywords: COVID-19; SARS-CoV-2 Delta variant; Nigeria; diabetes mellitus; hypertension; hypoxaemia; neutrophil-to-lymphocyte ratio; multimorbidity; resource-limited settings

1. Introduction

Nigeria experienced its third COVID-19 wave from July 2021, driven by the SARS-CoV-2 Delta (B.1.617.2) variant, with Lagos State again the national epicentre. Delta was associated with a higher risk of hospital admission than earlier variants [1], and its arrival in Nigeria preceded meaningful population vaccine coverage. Large Nigerian cohorts from the first two waves identified hypertension and diabetes as the commonest comorbidities among patients with COVID-19 and as independent predictors of death [2–

6]. Across Africa, the African COVID-19 Critical Care Outcomes Study (ACCCOS) reported high in-hospital mortality among critically ill patients and identified diabetes among the factors associated with death [7].

Fewer reports describe, at the patient level, how admission physiology, routine laboratory markers, comorbidity and treatment combined in individuals during the Delta wave in Nigeria. Such granular descriptions are useful in resource-limited settings where triage depends on inexpensive bedside tools. We therefore describe the clinical profile, management and outcomes of consecutive patients admitted to a COVID-19 isolation unit in Lagos during the Delta wave, and explore which features distinguished patients who died.

2. Materials and Methods

2.1. Setting

The Federal Medical Centre (FMC), Ebute-Metta, is a federal tertiary hospital in Lagos, Nigeria. Its COVID-19 isolation unit had negative-pressure single rooms, each with an individual bedside monitor and dedicated supplies. Care was delivered under strict infection prevention and control (IPC) procedures, including standardised donning and doffing of personal protective equipment. A consultant reviewed all patients daily, and a COVID-trained medical officer was available to patients at all times. Case data were reported routinely to the national public-health COVID-19 data registry.

2.2. Design and participants

This is a retrospective case series of all consecutive patients admitted to the unit between 1 August and 30 September 2021, the period during which the first author was seconded to the unit as COVID Unit Officer. Patients were admitted if they had laboratory-confirmed SARS-CoV-2 infection and met one or more of the unit's admission criteria: SpO_2 <92% on room air; respiratory rate >30 breaths/min or respiratory distress; a high-risk comorbidity or age ≥60 years; or inability to isolate safely at home. Infection was confirmed by a positive rapid antigen test and by reverse-transcription polymerase chain reaction (RT-PCR) performed at the Nigerian Institute of Medical Research (NIMR), with results available within 24 hours.

2.3. Variables

Data abstracted from the unit register comprised age, sex, comorbidities, date of symptom onset, date of admission, SpO_2 measured on room air at admission, and the admission full blood count (neutrophil and lymphocyte fractions as percentages of the white-cell differential, neutrophil-to-lymphocyte ratio [NLR] and platelet count). In-hospital interventions recorded were dexamethasone, ivermectin, remdesivir, non-invasive ventilation (NIV), chest imaging (radiograph or computed tomography) and vitamin supplementation. The outcome was in-hospital death or discharge alive. Length of stay was calculated from admission to outcome. Vaccination status and formal severity scores were not recorded in the register.

2.4. Data handling and statistical analysis

Data were de-identified before analysis, and each patient was assigned a study code. Register entries were checked against source records by the first author: one antigen result recorded in error was corrected, one missing outcome was completed from the case notes (discharged alive; discharge date and treatment data not recorded), and one repeat blood count was excluded. Continuous variables are summarised as median (range) and categorical variables as n/N. Non-survivors and survivors were compared using the exact

Mann–Whitney U test and Fisher's exact test. Exact (Clopper–Pearson) 95% confidence intervals (CIs) are reported for proportions. Because there were only four deaths, no multivariable modelling was attempted. All tests were two-sided, unadjusted for multiple comparisons, and are interpreted as exploratory. Analyses used Python 3 (pandas, SciPy and statsmodels).

3. Results

3.1. Patient characteristics

Fifteen consecutive patients were admitted (10 in August and 5 in September 2021). The median age was 57 years (range 16–81), and 10 (67%) were male. Nine (60%) had at least one comorbidity: diabetes plus hypertension (n = 4), hypertension alone (n = 2), diabetes alone (n = 1), prediabetes (n = 1) and suspected thyroid disease (n = 1). The median interval from symptom onset to admission was 7 days (range 3–14). The median admission SpO_2 on room air was 94% (range 83–100). Six patients (40%) met the SpO_2 <92% admission criterion, five of whom had SpO_2 <90%. The remaining nine were admitted on the basis of comorbidity or age, respiratory distress, or inability to isolate at home; the specific criterion was not recorded for each patient (Table 1).

3.2. Outcomes

Four patients died in hospital (26.7%; 95% CI 7.8–55.1), and 11 were discharged alive. All deaths occurred among patients admitted in August (4/10); none of the five patients admitted in September died. Deaths occurred on hospital days 2, 3, 10 and 16. Among survivors with a recorded discharge date (n = 10), the median length of stay was 5 days (range 3–15) (Figure 2).

3.3. Features associated with death

All four patients who died had both diabetes and hypertension, and all four patients with this combination died (4/4 vs 0/11; p = 0.001). Every death occurred in a patient with admission SpO_2 <90% (range 84–89%). Of the five patients with SpO_2 <90%, four died; the only survivor was a man aged 60–69 years with no comorbidity (SpO_2 83%). None of the ten patients with SpO_2 ≥90% died (p = 0.004). Diabetes–hypertension multimorbidity and hypoxaemia therefore overlapped completely among the patients who died (Figure 1a). Non-survivors had a lower lymphocyte fraction (median 8.6% vs 27.3%; p = 0.040) and a higher NLR (median 10.8 vs 2.4; p = 0.056), and tended to be older (median 76 vs 50 years; p = 0.10) (Figure 1b,c). Sex, the interval from symptom onset to admission, platelet count and length of stay did not differ between groups (Table 1).

3.4. Interventions

Among the 14 patients with treatment data, dexamethasone was given to 11, ivermectin to 11, vitamin supplements to 11, remdesivir to 6 and NIV to 7; 7 underwent chest imaging (Table 2). Interventions were used more often in hypoxaemic patients. One patient who died, with admission SpO_2 89%, did not receive dexamethasone. Of eight patients with admission SpO_2 ≥94%, six received dexamethasone and six received ivermectin. Two of these eight patients deteriorated during admission and were started on NIV; the timing of dexamethasone relative to any in-hospital oxygen requirement was not recorded. Because treatment followed clinical severity, associations between individual interventions and outcome were not interpreted.

Table 1. Characteristics of patients by in-hospital outcome.

Characteristic	All (n=15)	Died (n=4)	Survived (n=11)	p‡

Age, years	57 (16–81)	76 (50–80)	50 (16–81)	0.104
Age ≥60 years	7/15	3/4	4/11	0.282
Male sex	10/15	3/4	7/11	1.000
Any comorbidity	9/15	4/4	5/11	0.103
Diabetes + hypertension	4/15	4/4	0/11	0.001
Any diabetes	5/15	4/4	1/11	0.004
Any hypertension	6/15	4/4	2/11	0.011
Symptom onset to admission, days	7 (3–14)	6 (3–7)	7 (3–14)	0.851
Admission SpO_2 on room air, %	94 (83–100)	86.5 (84–89)	95 (83–100)	0.018
Admission SpO_2 <90%	5/15	4/4	1/11	0.004
Admission SpO_2 <92%	6/15	4/4	2/11	0.011
Lymphocytes, % of WBC	22.5 (4.3–48.9)	8.55 (4.3–22.5)	27.3 (9.7–48.9)	0.040
Neutrophils, % of WBC	65.1 (37.5–90.6)	85.5 (64–90.6)	65.1 (37.5–83.3)	0.078
Neutrophil-to-lymphocyte ratio	3.07 (0.87–21.07)	10.755 (2.84–21.07)	2.38 (0.87–8.59)	0.056
Platelets, $\times 10^9$/L	181 (66–327)	227.5 (154–327)	176.5 (66–259)	0.240
Dexamethasone	11/14	3/4	8/10	1.000
Ivermectin	11/14	4/4	7/10	0.505
Remdesivir	6/14	2/4	4/10	1.000
Non-invasive ventilation (any time)	7/14	3/4	4/10	0.559
Chest imaging (CXR/CT)	7/14	4/4	3/10	0.070
Vitamin supplements	11/14	4/4	7/10	0.505
Length of stay, days	5 (2–16)	6.5 (2–16)	5 (3–15)	0.945

Continuous variables are median (range); categorical variables are n/N with available data. ‡Exact Mann–Whitney U test or Fisher's exact test, two-sided, unadjusted, exploratory. Treatment denominators exclude one patient whose treatment data were not recorded; platelet count and length of stay n = 14. DM, diabetes mellitus; HTN, hypertension; WBC, white blood cells; NIV, non-invasive ventilation.

Table 2. Interventions by admission oxygen saturation.

Intervention	**All (n=14)**	**SpO_2 <90% (n=5)**	**SpO_2 90–93% (n=1)**	**SpO_2 ≥94% (n=8)**
Dexamethasone	11/14	4/5	1/1	6/8
Ivermectin	11/14	5/5	0/1	6/8
Remdesivir	6/14	3/5	1/1	2/8
Non-invasive ventilation	7/14	4/5	1/1	2/8†
Chest imaging (CXR/CT)	7/14	5/5	0/1	2/8
Vitamin supplements	11/14	5/5	0/1	6/8

Values are n/N among 14 patients with treatment data. The single patient with SpO_2 90–93% (91%) received dexamethasone, remdesivir and NIV. †Includes two patients with admission SpO_2 ≥94% who were started on NIV after in-hospital deterioration.

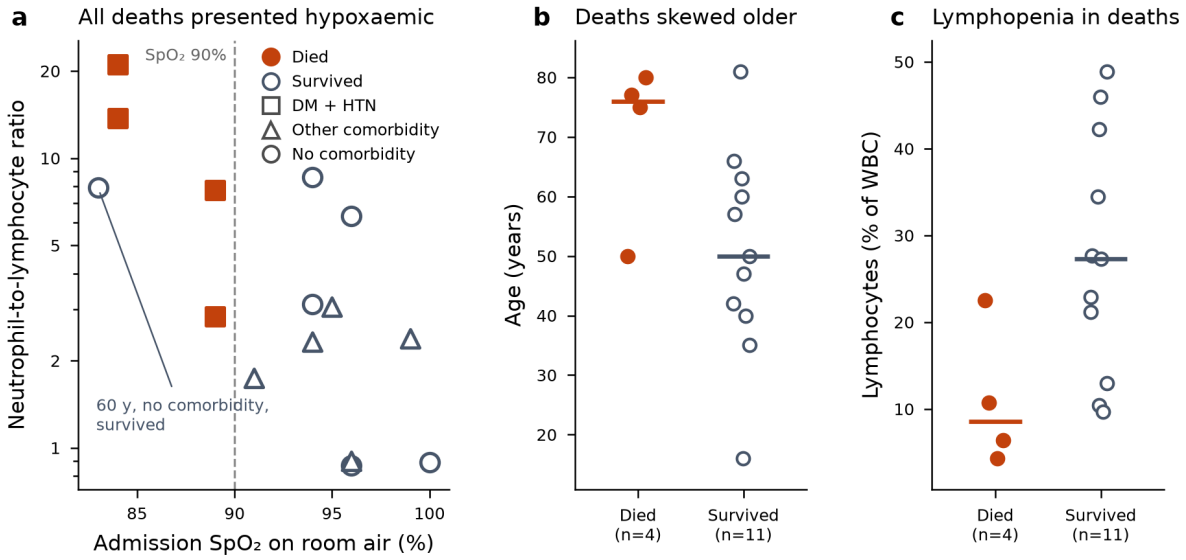


Figure 1. Admission risk markers by outcome (n = 15). (a) Room-air SpO_2 against neutrophil-to-lymphocyte ratio (log scale). Filled orange markers, died; open grey markers, survived; marker shape indicates comorbidity. The dashed line marks SpO_2 90%. Two survivors overlap at SpO_2 96% (NLR 0.87 and 0.90). (b) Age and (c) lymphocyte fraction by outcome; horizontal bars are medians.

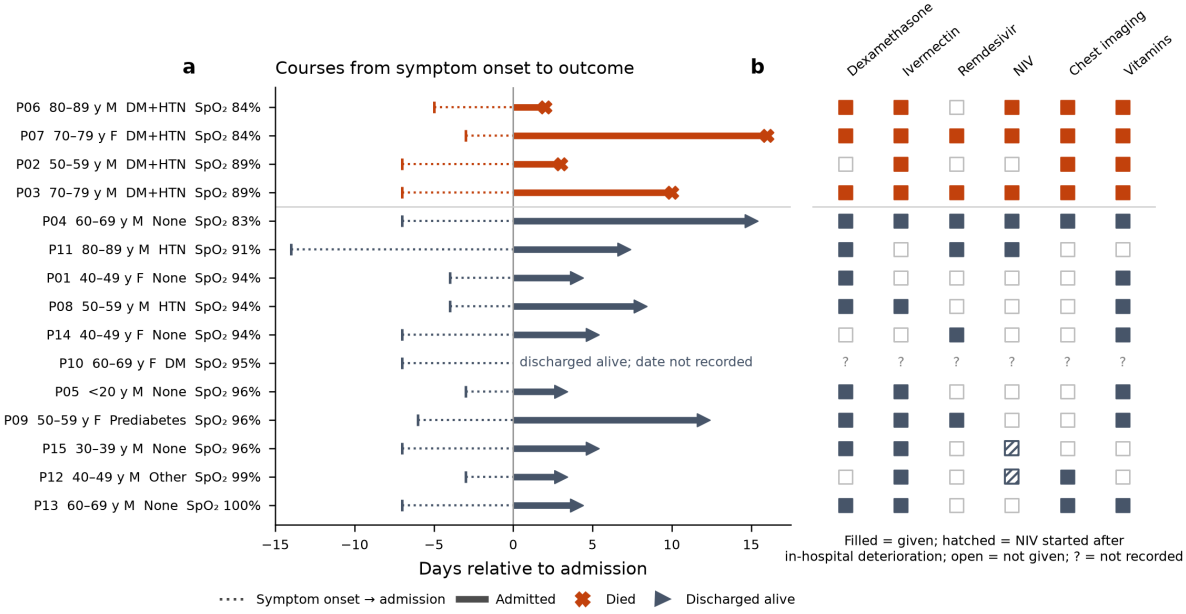


Figure 2. Individual patient courses and interventions, ordered by outcome and then admission SpO_2. Ages are shown in 10-year bands. (a) Dotted line, symptom onset to admission; solid bar, admission to outcome. One patient was discharged alive on an unrecorded date. (b) Interventions received; hatched squares indicate NIV started after in-hospital deterioration.

4. Discussion

In this series of consecutive Delta-wave admissions to a Lagos isolation unit, about one in four patients died, and every death occurred within a single clinical phenotype: coexisting diabetes and hypertension with hypoxaemia at presentation, usually accompanied by marked lymphopenia. No patient without diabetes–hypertension multimorbidity died, and no patient presenting with SpO_2 ≥90% died.

These observations are consistent with Nigerian cohorts from the first and second waves, in which hypertension and diabetes were the commonest comorbidities and predicted death [2–6], with ACCCOS [7], and with large international cohorts [8]. Admission hypoxaemia is among the strongest prognostic markers in COVID-19 [9], and an elevated NLR predicts disease severity and mortality [10]. The contribution of the present series is phenotypic resolution at the patient level: in a Delta-wave population, these risk markers occurred together in the same individuals rather than being spread across the cohort. From a precision-health perspective, the high-risk profile can be recognised with a pulse oximeter and a full blood count, tools available in almost every Nigerian hospital. This supports simple, phenotype-based triage: patients with cardiometabolic multimorbidity who present hypoxaemic could be flagged for early escalation, close monitoring and prompt evidence-based therapy, and the same group could be prioritised for vaccination and early presentation in future waves.

The crude mortality of 26.7% is higher than that reported in large first- and second-wave Lagos cohorts (approximately 3–9%) [2,3,6]. Several factors probably contribute: admission was restricted to patients meeting clinical or social criteria, a third of admitted patients were hypoxaemic, Delta carried a higher risk of severe disease [1], and population vaccine coverage in mid-2021 was low. The absence of deaths among September admissions should not be over-interpreted, as no patient with diabetes–hypertension multimorbidity was admitted that month.

Treatment patterns reflect the evolving evidence of 2021. Dexamethasone, which reduces mortality in patients requiring oxygen or ventilation but showed no benefit in those not receiving oxygen in the RECOVERY trial [11], was given to most patients, including six of eight who were not hypoxaemic on admission. Because the timing of dexamethasone relative to any in-hospital oxygen requirement was not recorded, and two of these patients later deteriorated and required NIV, this observation is descriptive and does not by itself indicate inappropriate use. Ivermectin and vitamin supplements were used widely. Randomised trials and systematic reviews have since shown no clinical benefit of ivermectin [12,13] or of high-dose zinc and ascorbic acid [14], and the WHO living guideline has advised against ivermectin outside clinical trials since March 2021 [15]. Remdesivir has at most a small effect on mortality in hospitalised patients [16]. Because treatment was allocated according to severity, no inference about treatment effects can be drawn from these data. The pattern does, however, support rapid, guideline-linked prescribing support in future epidemic responses.

4.1. Strengths and limitations

Strengths include the inclusion of all consecutive admissions, laboratory confirmation by RT-PCR in every patient, a standardised care environment with daily consultant review, and complete admission physiology and blood counts. The limitations are substantial. This is a small, single-centre retrospective series with four deaths, so all estimates are imprecise and no adjustment for confounding was possible. Diabetes–hypertension multimorbidity and hypoxaemia were perfectly collinear among non-survivors, so their independent contributions cannot be separated. Vaccination status, severity scores, inflammatory markers (C-reactive protein, D-dimer, ferritin), glycaemic control, the timing of individual treatments and cause of death were not recorded. Blood counts were available as differential percentages rather than absolute counts. Admission was criteria-based, so the observed mortality is not generalisable to all patients with

COVID-19. Discharge date and treatment data were missing for one patient. Findings should be regarded as hypothesis-generating [17,18].

5. Conclusions

In this Delta-wave series from a Lagos isolation unit, every in-hospital COVID-19 death occurred in a patient with diabetes–hypertension multimorbidity who presented with hypoxaemia. These inexpensive bedside markers deserve prospective validation as triage tools in Nigerian and other resource-limited settings, alongside efforts to align epidemic-response prescribing with current evidence.

Author Contributions

Conceptualisation, O.D.O. and A.E.; methodology, O.D.O. and A.E.; investigation and data collection, O.D.O. and S.M.; data curation, O.D.O.; formal analysis, O.D.O.; writing—original draft preparation, O.D.O.; writing—review and editing, S.M. and A.E.; supervision, A.E. All authors have read and agreed to the posted version of the manuscript.

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Ethics Statement

Data were collected during routine clinical care and public-health surveillance in the COVID-19 isolation unit and were reported to the national COVID-19 data registry. All data were de-identified before analysis; no names, hospital numbers or dates of birth are reported, and ages are presented in aggregate or in 10-year bands. Patient care was not altered for the purposes of this report.

Informed Consent Statement

Individual patient consent was not sought for this retrospective analysis of de-identified routinely collected data. No identifiable patient information is presented.

Data Availability Statement

The de-identified dataset supporting this study is available from the corresponding author on reasonable request.

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Conflicts of Interest

The authors declare no conflicts of interest.

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