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Evaluation of patient characteristics, management and outcomes for COVID-19 at district hospitals in the Western Cape, South Africa: descriptive observational study

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ABSTRACT

Objectives To describe the characteristics, clinical management and outcomes of patients with COVID-19 at district hospitals.

Design A descriptive observational cross-sectional study.

Setting District hospitals (4 in metro and 4 in rural health services) in the Western Cape, South Africa. District hospitals were small (<150 beds) and led by family physicians.

Participants All patients who presented to the hospitals' emergency centre and who tested positive for COVID-19 between March and June 2020.

Primary and secondary outcome measures Source of referral, presenting symptoms, demographics, comorbidities, clinical assessment and management, laboratory turnaround time, clinical outcomes, factors related to mortality, length of stay and location.

Results 1376 patients (73.9% metro, 26.1% rural). Mean age 46.3 years (SD 16.3), 58.5% females. The majority were self-referred (71%) and had comorbidities (67%): hypertension (41%), type 2 diabetes (25%), HIV (14%) and overweight/obesity (19%). Assessment of COVID-19 was mild (49%), moderate (18%) and severe (24%). Test turnaround time (median 3.0 days (IQR 2.0–5.0 days)) was longer than length of stay (median 2.0 day (IQR 2.0–3.0)). The most common treatment was oxygen (41%) and only 0.8% were intubated and ventilated. Overall mortality was 11%. Most were discharged home (60%) and only 9% transferred to higher levels of care. Increasing age (OR 1.06 (95% CI 1.04 to 1.07)), male (OR 2.02 (95% CI 1.37 to 2.98)), overweight/obesity (OR 1.58 (95% CI 1.02 to 2.46)), type 2 diabetes (OR 1.84 (95% CI 1.24 to 2.73)), HIV (OR 3.41 (95% CI 2.06 to 5.65)), chronic kidney disease (OR 5.16 (95% CI 2.82 to 9.43)) were significantly linked with mortality (p<0.05). Pulmonary diseases (tuberculosis (TB), asthma, chronic obstructive pulmonary disease, post-TB structural lung disease) were not associated with increased mortality.

Conclusion District hospitals supported primary care and shielded tertiary hospitals. Patients had high levels of comorbidities and similar clinical pictures to that reported

Strengths and limitations of this study

► The whole study population was included over a 4-month period at the height of the epidemic from eight district hospitals with few missing records.
► A comprehensive dataset on presentation, assessment, management and outcomes was captured.
► The size of the study population enabled identification of risk factors associated with mortality.
► Data were dependent on the accuracy of medical records and clinical skills.
► District hospitals without family physicians may have different quality of care, which limits generalisability.

elsewhere. Most patients were treated as people under investigation. Mortality was comparable to similar settings and risk factors identified.

INTRODUCTION

COVID-19 is a global pandemic that has affected all regions of the world, although Africa has so far been less affected than predicted.[1] Given the number of low- and middle-income countries, and relatively weak health systems, the pandemic is expected to significantly impact African communities.[2] Within the African continent, South Africa has had the most reported cases and the Western Cape has been one of the leading hotspots.[1 3]

Clinical findings among confirmed COVID-19 cases in China showed the most common complaints were fever (83%), cough (82%), difficulty breathing (31%), fatigue and myalgia (11%).[4] Non-respiratory injury was identified by elevated levels of aspartate aminotransferase (20%), creatinine (6%) and creatine kinase (15%).[5]

Findings from another Chinese study showed that older patients and those with comorbidity had poorer clinical outcomes.[5] Multimorbidity was also correlated with poorer clinical outcomes.[6] Comorbidity with cardio-pulmonary diseases was a particular concern, such as diabetes, hypertension, asthma and chronic obstructive pulmonary disease (COPD). In South Africa, there was also concern with regard to the large numbers of people with HIV, particularly those who were immunocompromised, due to no or inadequate antiretroviral treatment. South Africa has 20% of all people living with HIV in the world and this is accompanied by a high incidence of tuberculosis (TB).[7 8] Patients with active TB or post-TB structural lung damage were also a concern in our context.

Most clinical research has focused on tertiary hospitals with high-care or intensive care units (ICU). Little is known, therefore, about the types of patients seen at district hospitals and their clinical course with the expertise and equipment available at this level of the health system and in this African context. In South Africa, district hospitals usually have <150 beds and are run by generalists with male, female, maternity and paediatrics wards as well as emergency centres (EC). They are the first referral point, particularly in remote and rural areas, for patients from primary care.

In Africa, primary or district hospitals do not provide intensive or critical care and have limited capacity for prolonged ventilation. At the same time, tertiary referral hospitals may not be able to receive patients if their ICU facilities are full or they are very distant. Elsewhere in Africa it has been suggested that district hospitals should focus more on the provision of oxygen therapy as a more valuable intervention than ventilation, as ventilation requires adequate equipment and expertise, with a risk of harm to the patient and transmission of the virus during intubation.[9] Guidelines have also been put in place to determine which patients should be prioritised for ICU and which critically ill patients should be managed with oxygen and if necessary palliative care.[10] In June 2020, Cape Town also opened field hospitals, which had the ability to manage patients with COVID-19 at a level of care similar to a district hospital.[11]

This study will describe the type of patients referred to district hospitals run by family physicians in the Western Cape and evaluate their presentation, clinical management and outcomes. This data will help to provide a more complete picture of how COVID-19 is affecting our population as the patient population seen at district hospitals is different to that seen at tertiary hospitals and African populations may differ from those in Europe, Asia or America.

The aim of this study, therefore, was to describe the characteristics, clinical management and outcomes of patients with COVID-19 presenting to district hospitals in the Western Cape from March 2020 to June 2020. The specific objectives were to describe the original source of referral, the presenting symptoms, the patients' demographics, the presence of comorbidities, the clinical assessment and management, the turnaround time (TOT) for laboratory results, the clinical outcomes and factors related to mortality, the length of stay and to compare district hospitals in rural health services (RHS) and metro health services (MHS).

METHODS
Study design
This was a descriptive observational cross-sectional study by means of a retrospective audit of medical records.

Setting
The Western Cape had 33 district hospitals: 28 small (<150 beds), 3 medium (150–299 beds) and 2 large (300–600 beds). Small district hospitals in this study operated as generalist environments with family physicians as the most senior clinicians (one district hospital had an internal medicine physician running their inpatient COVID-19 ward). A family physician is a specialist in family medicine. In South Africa, family physicians are trained for the district hospital setting as well as primary care.

In terms of the continuum of care for COVID-19, these district hospitals received patients from the public sector primary care facilities in their catchment area. The private sector could also refer patients, without insurance, to the district hospitals. Patients in primary care, with more than mild symptoms, were referred for further management, although those requiring critical or intensive care could be referred directly to regional or tertiary hospitals. Therefore, the profile of patients seen and treated at district hospitals will be different to those referred to regional and tertiary hospitals as the capacity for critical care and intensive care was much less or non-existent. These small district hospitals typically had ECs and re-organised their wards into 'hot' and 'cold' streams for COVID-19. Patients could be intubated and ventilated in the EC, prior to transfer, and there was not usually access to high flow oxygen, which was only installed in June in some hospitals. District hospitals could discharge patients to home, transfer them to a field hospital or to higher-level care.

Study population and selection of participants
The study engaged the Stellenbosch University Family Physician Research Network and the family physicians within that network who worked at small district hospitals in the province. Eight district hospitals, four from the MHS in Cape Town and three in the RHS, opted to take part. The study excluded medium-large metropolitan district hospitals that were organised along specialist departmental lines and which delivered a different package of care. George Regional Hospital was also included in the RHS, as its Department of Family Medicine offered district hospital services to the surrounding area and ran the EC.

From these eight facilities, all patients who presented to the EC and who tested positive for COVID-19 were included between March and June 2020. There was no sampling or other exclusion criteria.

Data collection

Patients were identified from the laboratory results and their folders drawn from the records department. Data were extracted from the medical records using a standardised data collection tool by the family physicians at each hospital. Data were collected electronically using REDCap software on internet-connected devices available to the researchers. Overweight and obesity were defined as a body mass index >25 kg/m^2. The South African Triage Scale was used by clinicians where red is for an immediate emergency, orange is very urgent, yellow is urgent and green is non-urgent.[12] COVID-19 was classified according to clinical guidelines issued by the Western Cape Government: Health.[13]

The data collection tool was designed to collect data on the objectives listed above and the tool was validated by all the family physicians involved in the study prior to data collection. The tool was piloted by one district hospital prior to use.

Data analysis

Data were exported from REDCap to the Statistical Package for Social Sciences V.26. There was no missing data. Means with SD were used to describe continuous variables that were normally distributed and medians with IQRs to describe continuous data that were not normally distributed. Categorical data were analysed using frequencies and percentages.

Categorical variables were compared by Pearson's χ^2 test. An independent T-test was used to compare continuous variables with binary variables if data were normally distributed and a Mann-Whitney U test if data were not normally distributed. Analysis of variance was used to compare nominal variables with normally distributed numeric variables.

Univariate binary logistic regression was used to determine ORs for factors that might be associated with mortality (age, sex, comorbidities and location). Factors with a p value <0.1 were then entered into a multiple variable forward stepwise binary logistic regression to determine which factors remained significantly associated with mortality.

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

RESULTS
Study sample

Overall, 1376 patients were included in the study for this period and 1017 (73.9%) were from the MHS and 359 (26.1%) from RHS. The mean age of patients was 46.3 years (SD 16.3 years) and patients were significantly older in the MHS compared with RHS (MHS 48.1 years (SD 16.1), RHS 41.4 years (SD 15.7), mean difference 6.73 years (4.80–8.66), p<0.001). Overall, there were 571 (41.5%) males and 805 (58.5%) females. There were significantly more females in the MHS sample than RHS (60.9% vs 51.8% female, p=0.003).

Presentation and assessment

Table 1 shows the characteristics of patients on arrival at the EC. Only 10% of patients were referred from public sector primary care facilities and the majority (70.6%) were self-referred. Patients were significantly more likely to be referred from a primary care facility in the RHS as shown in table 1.

The most common symptoms were cough, shortness of breath, fever, body pains/myalgia and sore throat. The most common abnormal clinical signs were a raised respiratory rate, tachycardia, hyperglycaemia, decreased oxygen saturation and raised systolic blood pressure. The impression was that MHS patients were sicker (more dyspnoea, lower oxygen saturation, more confused) than those in the RHS at presentation and RHS patients had more symptoms from an earlier phase of the disease (sore throat, myalgia, nasal symptoms, cough).

Table 2 presents the comorbidities of patients. A third of patients had no known comorbidities. The most common comorbidities were hypertension, type 2 diabetes, overweight/obesity and HIV. Patients in the MHS had significantly more comorbidities than those in the RHS. On arrival the levels of prior control for many comorbidities was unknown, particularly in the rural areas. People with type 2 diabetes had the highest proportion that were uncontrolled.

Table 3 presents the initial assessment and final disposition from the EC. There was some mismatch between the initial triage and final assessment, with 53.1% of patients triaged as yellow and 17.1% of patients triaged as orange, being clinically assessed as mild COVID-19, and half (49.1%) of all patients were assessed as mild. Patients from the RHS were significantly more likely to be assessed as mild and less likely to be admitted. Overall, 42.2% were discharged home from the EC, 47.4% admitted and only 6.2% transferred immediately to a higher level of care.

Management in hospital

Most patients were admitted as people under investigation and managed without a definitive diagnosis, as the TOT for the test result (median 3.0 days (IQR 2.0–5.0 days)) was longer than the length of stay (median 2.0 day (IQR 2.0–3.0)). There was no difference in the TOT between MHS and RHS (MHS median 3.0 days (IQR 3.0–4.0) and RHS 2.0 days (IQR 2.0–3.0), p=0.113).

Half of all patients did not receive a chest radiograph in the EC or on admission (695 (50.5%)) and this was significantly more likely in rural areas (MHS 41.9% vs RHS 74.7%, p<0.001). The typical appearance was

Table 1 Characteristics of patients on arrival at the EC

	All n=1376 n (%)	Metro n=1017 n (%)	Rural n=359 n (%)	P value
Source of referral				
Primary care facility	137 (10.0)	69 (6.8)	68 (18.9)	<0.001
Private general practice	147 (10.7)	105 (10.3)	42 (11.7)	
Self-referral	972 (70.6)	736 (72.4)	235 (65.5)	
Higher hospital	5 (0.4)	5 (0.5)	0 (0.0)	
Other	40 (2.9)	26 (2.6)	14 (3.9)	
Not known	75 (5.5)	75 (7.4)	0 (0.0)	
Symptoms recorded on arrival				
Sore throat	332 (24.1)	186 (18.3)	146 (40.7)	<0.001
Nasal symptoms	93 (6.8)	61 (6.0)	32 (8.9)	0.059
Body pains/myalgia	360 (26.2)	248 (24.4)	112 (31.2)	0.012
Fever	441 (32.0)	302 (29.7)	139 (38.7)	0.002
Cough	877 (63.7)	612 (60.2)	265 (73.8)	<0.001
Shortness of breath	717 (52.1)	545 (53.6)	172 (47.9)	0.062
Fatigue	181 (13.2)	155 (15.3)	26 (7.2)	<0.001
Loss smell	64 (4.7)	43 (4.2)	21 (5.8)	0.211
Loss taste	49 (3.6)	29 (2.9)	20 (5.6)	0.017
Diarrhoea	82 (6.0)	70 (6.9)	12 (3.3)	0.015
Headache	222 (16.1)	157 (15.5)	65 (18.1)	0.240
Other	298 (21.7)	250 (24.6)	47 (13.1)	<0.001
Observations recorded on arrival				
Temperature >37.5°C	162 (12.4)	96 (10.0)	66 (19.0)	<0.001
Respiratory rate >18/min	650 (50.5)	505 (52.7)	145 (43.9)	0.007
Pulse rate >100/min	646 (47.9)	491 (49.3)	154 (43.8)	0.013
Systolic BP <90 mm Hg	31 (2.6)	28 (3.2)	3 (1.0)	0.08
Systolic BP >140 mm Hg	360 (30.0)	259 (29.3)	101 (32.3)	
Diastolic BP <60 mm Hg	101 (8.4)	87 (9.8)	14 (4.5)	0.008
Diastolic BP >90 mm Hg	217 (18.1)	152 (17.2)	65 (20.7)	
Oxygen saturation <95%	557 (41.9)	439 (44.8)	118 (33.8)	<0.001
Random blood glucose <4.0 mmol/L	22 (2.5)	15 (2.1)	7 (3.9)	0.228
Random blood glucose >7.8 mmol/L	397 (44.3)	324 (45.4)	73 (40.3)	
Alert	1264 (91.9)	921 (90.6)	342 (95.3)	0.034
Confused but responds to verbal commands	82 (6.0)	69 (6.8)	13 (3.6)	
Unconscious but responds to pain	10 (0.7)	7 (0.7)	3 (0.8)	
Unconscious with no response to pain	6 (0.4)	5 (0.5)	1 (0.3)	

BP, blood pressure; EC, emergency centre.

bilateral changes in the lower or mid-zone, a ground glass appearance or consolidation. There were no major differences in the radiograph findings between MHS and RHS.

Table 4 presents the treatments for COVID-19. Only 40.6% received any form of oxygen therapy and very few were intubated (0.8%). Those admitted were usually treated with oxygen, low molecular weight heparin (enoxaparin sodium) and antibiotics (ceftriaxone, azithromycin or co-amoxiclav) and far fewer patients were treated with proning or steroids. Proning was only used in 24% of those with severe or critical COVID-19.

Table 5 presents the final clinical outcomes. The overall mortality rate was 11.0% and 19.6% for those admitted. Mortality rose to 57.3% for those that were critically ill, 21.8% for severe cases, 7.5% for moderate cases and 1.8% for mild. Half of those admitted were discharged home

Table 2 Comorbidities of patients with COVID-19

	All n=1376 n (%)	Metro n=1017 n (%)	Rural n=359 n (%)	P value
Comorbidity				
Overweight/Obesity	269 (19.5)	208 (20.5)	61 (17.0)	0.153
Type 1 diabetes	17 (1.2)	15 (1.5)	2 (0.6)	0.175
Type 2 diabetes	347 (25.2)	273 (26.9)	74 (20.6)	0.019
Hypercholesterolaemia	83 (6.0)	77 (7.6)	6 (1.7)	<0.001
Hypertension	564 (41.0)	454 (44.7)	109 (30.4)	<0.001
Cardiac failure	58 (4.2)	51 (5.0)	7 (1.9)	0.013
Ischaemic heart disease	25 (1.8)	24 (2.4)	1 (0.3)	0.011
Asthma	67 (4.9)	52 (5.1)	15 (4.2)	0.477
COPD	50 (3.6)	38 (3.7)	12 (3.3)	0.729
Post-TB lung damage	12 (0.9)	8 (0.8)	4 (1.1)	0.567
HIV	195 (14.2)	156 (15.4)	39 (10.9)	0.036
Active TB on treatment	23 (1.7)	20 (2.0)	3 (0.8)	0.150
Previous TB	49 (3.6)	40 (3.9)	9 (2.5)	0.209
Cancer on treatment	10 (0.7)	9 (0.9)	1 (0.3)	0.244
Previous cancer	2 (0.1)	2 (0.2)	0 (0.0)	0.400
Chronic kidney disease	60 (4.4)	55 (5.4)	5 (1.4)	0.001
None	450 (32.7)	276 (27.2)	174 (48.5)	<0.001
Tobacco smoker	95/621 (15.3)	80/490 (16.3)	15/131 (11.5)	0.168
Previous control of comorbidity				
Diabetes n=348				
Normal HbA1c <7%	32 (9.2)	30 (10.8)	2 (2.9)	0.002
Controlled HbA1c 7%–8%	41 (11.8)	34 (12.2)	7 (10.1)	
Uncontrolled HbA1c >8 and <10%	68 (19.5)	56 (20.1)	12 (17.4)	
Very uncontrolled ≥10%	131 (37.6)	110 (39.4)	21 (30.4)	
Unknown	76 (21.8)	49 (17.6)	27 (39.1)	
Hypertension n=446				
Well controlled	165 (37.0)	150 (41.6)	14 (16.7)	<0.001
Uncontrolled	88 (19.7)	75 (20.8)	13 (15.5)	
Not known	193 (43.3)	136 (37.7)	57 (67.9)	
Asthma n=72				
Well controlled	23 (31.9)	21 (51.2)	2 (6.5)	<0.001
Partly controlled	10 (13.9)	6 (14.6)	4 (12.9)	
Uncontrolled	5 (6.9)	5 (12.2)	0 (0.0)	
Unknown	34 (47.2)	9 (22.0)	25 (80.6)	
COPD n=56				
Mild	7 (12.5)	5 (15.6)	2 (8.3)	<0.001
Moderate	11 (19.6)	9 (28.1)	2 (8.3)	
Severe	13 (23.2)	12 (37.5)	1 (4.2)	
Unknown	25 (44.6)	6 (18.8)	19 (79.2)	
HIV n=180				

Table 2 Continued

	All n=1376 n (%)	Metro n=1017 n (%)	Rural n=359 n (%)	P value
Well controlled	96 (53.3)	79 (57.7)	17 (39.5)	0.004
Uncontrolled	22 (12.2)	15 (10.9)	7 (16.3)	
Unknown	43 (23.9)	25 (18.2)	18 (41.9)	
No ART	16 (8.9)	16 (11.7)	0 (0.0)	
New on ART	3 (1.7)	2 (1.5)	1 (2.3)	

ART, antiretroviral treatment; COPD, chronic obstructive pulmonary disease; HbA1c, haemoglobin A1c; TB, tuberculosis.

(49.7%) and only 8.7% were transferred to a higher level of care and this was significantly more likely in the MHS (p<0.001). The MHS also made use of the field hospitals.

Risk factors for mortality

In the multiple variable analysis, increasing age, male sex, overweight/obesity, type 2 diabetes, chronic kidney disease, cardiac failure, HIV and treatment for cancer were all independently associated with a higher risk of death (table 6). Chronic respiratory conditions, such as asthma, COPD, post-TB lung damage and tobacco smoking were not associated with increased risk of mortality. Hypertension and hypercholesterolaemia were also not retained as risk factors in the multiple variable analysis. There was no difference in risk of mortality between the MHS and RHS. In addition, there was a significant relationship between

poorer categories of diabetic control and mortality (OR 2.28 ((95% CI 1.25 to 4.16), p=0.007), but not with poor control of HIV (unsuppressed viral load) (OR 1.96 (95% CI 0.62 to 6.23), p=0.253). There was also no significant relationship with being on antiretroviral treatment (OR 0.879 (95% CI 0.524 to 1.48), p=0.627).

DISCUSSION
Contribution of district hospitals to the health system response

The majority of people with COVID-19 were self-referred and bypassed the gatekeeping role expected of public sector primary care facilities. Primary care facilities are often closed on weekends and afterhours making the

Table 3 Initial assessment and disposition from the emergency centre

	All n=1376 n (%)	Metro n=1017 n (%)	Rural n=359 n (%)	P value
Initial assessment in emergency centre				
Triage green	455 (33.1)	267 (26.4)	188 (53.1)	<0.001
Triage yellow	292 (21.3)	200 (19.7)	91 (25.7)	
Triage orange	516 (37.7)	453 (44.7)	63 (17.8)	
Triage red	105 (7.7)	93 (9.2)	12 (3.4)	
Mild COVID	676 (49.1)	443 (43.6)	232 (64.6)	<0.001
Moderate COVID	252 (18.3)	191 (18.8)	61 (17.0)	
Severe COVID	335 (24.3)	303 (29.8)	32 (8.9)	
Critical COVID	82 (6.0)	72 (7.1)	10 (2.8)	
Unknown COVID	31 (2.3)	7 (0.7)	24 (6.7)	
Disposition from emergency centre				
Discharged home	581 (42.2)	378 (37.2)	203 (56.5)	<0.001
Transferred to higher level	85 (6.2)	66 (6.5)	19 (5.3)	
Transferred to assisted isolation	12 (0.9)	2 (0.2)	10 (2.8)	
Transferred to field hospital	20 (1.5)	19 (1.9)	1 (0.3)	
Admitted to district hospital	652 (47.4)	531 (52.2)	121 (33.7)	
Died	13 (0.9)	10 (1.0)	3 (0.8)	
Other	13 (0.9)	11 (1.1)	2 (0.6)	

Table 4 Treatment received at the district hospital

	All n=1376 n (%)	Admitted n=625 n (%)	Metro n=1017 n (%)	Rural n=359 n (%)	P value
Any form of oxygen	558 (40.6)	461 (70.7)	452 (44.5)	106 (29.5)	<0.001
Oxygen by nasal prongs 1–4 L/min	265 (19.3)	212 (32.5)	226 (22.2)	39 (10.9)	<0.001
Oxygen by facemask 6–10 L/min	240 (17.4)	212 (32.5)	207 (20.4)	33 (9.2)	<0.001
Oxygen with non-rebreather reservoir bag 10–15 L/min	177 (12.9)	130 (19.9)	136 (13.4)	41 (11.4)	0.339
Oxygen high flow >15 L/min	12 (0.9)	8 (1.2)	6 (0.6)	6 (1.7)	0.058
Intubation and ventilation	11 (0.8)	3 (0.5)	5 (0.5)	6 (1.7)	0.031
Proning	142 (10.3)	105 (16.1)	135 (13.3)	7 (1.9)	<0.001
Enoxaparin sodium any	583 (42.4)	503 (77.1)	504 (49.6)	79 (22.0)	<0.001
Enoxaparin sodium 40 mg/day	308 (22.4)	272 (41.7)	250 (24.6)	58 (16.2)	0.001
Enoxaparin sodium 1 mg/kg daily	218 (15.8)	191 (29.3)	203 (20.0)	15 (4.2)	<0.001
Enoxaparin sodium 1 mg/kg two times per day	74 (5.4)	57 (8.7)	67 (6.6)	7 (1.9)	0.001
Ceftriaxone	556 (40.4)	460 (70.6)	501 (49.3)	55 (15.3)	<0.001
Azithromycin	541 (39.3)	427 (65.5)	440 (43.3)	101 (28.1)	<0.001
Co-amoxiclav	166 (12.1)	106 (16.3)	80 (7.9)	86 (24.0)	<0.001
Any steroid	253 (18.4)	183 (28.1)	196 (19.3)	57 (15.9)	0.151
Dexamethasone	111 (8.1)	78 (12.0)	83 (8.2)	28 (7.8)	0.825
Hydrocortisone	15 (1.1)	12 (1.8)	13 (1.3)	2 (0.6)	0.257
Prednisone	131 (9.5)	97 (14.9)	102 (10.0)	29 (8.1)	0.277

district hospital EC the next available point of access. Primary care facilities also de-escalated during the epidemic and people were turned away or advised to stay away as much as possible,[14] while there was no restrictions on access to district hospitals. In some areas, primary care facilities temporarily closed when staff were infected. Although primary care facilities could test, the district hospitals had larger and more visible testing centres. This, in addition to fear of more severe disease and more trust in hospital-based services, may have led people to present directly to the hospital. In rural areas, where the hospital was more geographically distant, more people entered the system via primary care facilities. District hospitals, therefore, played an important role in primary care during the epidemic and this is reflected in the findings that 49% of patients seen had mild COVID-19% and 42% were immediately discharged home from the EC.

This also reflects the need to improve access to primary care in South Africa.[15]

District hospitals reduced pressure on tertiary hospitals with ICU and critical care beds particularly for those with moderate and severe COVID-19. Of those with moderate COVID-19, only 9% were transferred to tertiary hospitals and mortality was 7.5%. For those with severe disease, 17% were transferred and mortality was 22%, which compares favourably with reports from high-income settings.[16] District hospitals were unable to manage critically ill patients, as they did not have ICU or critical care facilities.

The introduction of field hospitals, such as at the Cape Town International Convention Centre,[17] also took pressure off acute hospitals and 13.5% of patients were transferred for ongoing care thus creating additional capacity at the district hospital. The first field hospital only

Table 5 Clinical outcomes at the district hospitals

Clinical outcome	Admitted n=652 n (%)	All n=1376 n (%)	Metro n=1017 n (%)	Rural n=359 n (%)	Mild n=676 n (%)	Moderate n=252 n (%)	Severe n=335 n (%)	Critical n=82 n (%)
Died	128 (19.6)	151 (11.0)	118 (11.6)	33 (9.2)	12 (1.8)	19 (7.5)	73 (21.8)	47 (57.3)
Discharged home	324 (49.7)	831 (60.4)	577 (56.8)	253 (70.5)	525 (77.7)	147 (58.3)	130 (38.8)	7 (8.5)
Transferred tertiary hospital	57 (8.7)	118 (8.6)	115 (11.3)	3 (0.8)	20 (3.0)	23 (9.1)	55 (16.4)	20 (24.4)
Transferred assisted isolation	30 (4.6)	47 (3.4)	20 (2.0)	27 (7.5)	26 (3.8)	11 (4.4)	3 (0.9)	0 (0.0)
Transferred field hospital	88 (13.5)	105 (7.6)	104 (10.2)	1 (0.3)	1.3 (1.9)	28 (11.1)	55 (16.4)	7 (8.5)

Table 6 Risk factors for death from COVID-19

Variable	Unadjusted OR (95% CI)	P value
Cancer on treatment	12.63 (3.5 to 42.3)	<0.001
Chronic kidney disease	10.65 (6.21 to 18.28)	<0.001
Cancer previous	8.16 (0.51 to 131.14)	0.138
Cardiac failure	5.63 (3.21 to 9.87)	<0.001
Post-TB SLD	4.14 (1.23 to 13.9)	0.022
Hypertension	3.95 (2.73 to 5.70)	<0.001
Type 2 diabetes	3.1 (2.2 to 4.3)	<0.001
TB on treatment	2.94 (1.14 to 7.57)	0.026
Ischaemic heart disease	2.06 (0.76 to 5.58)	0.154
Hypercholesterolaemia	1.88 (1.04 to 3.37)	0.035
TB previous	1.88 (0.89 to 3.95)	0.097
Overweight/Obese	1.69 (1.15 to 2.49)	0.007
HIV	1.67 (1.09 to 2.56)	0.019
Male sex	1.63 (1.16 to 2.30)	0.005
COPD	1.34 (0.59 to 3.03)	0.487
Asthma	1.11 (0.52 to 2.36)	0.795
Type 1 diabetes	1.08 (0.24 to 4.78)	0.916
Increasing age	1.06 (1.05 to 1.07)	<0.001
Turnaround time	1.02 (0.99 to 1.06)	0.216
Tobacco smoking	1.01 (0.46 to 2.21)	0.986
Length of admission	0.97 (0.93 to 1.02)	0.219
Rural versus metro services	0.77 (0.51 to 1.16)	0.208
No comorbidities	0.17 (0.09 to 0.30)	<0.001
Variable	**Adjusted OR (95% CI)**	**P value**
Cancer on treatment	7.45 (1.87 to 29.89)	0.004
Chronic kidney disease	5.16 (2.82 to 9.43)	<0.001
HIV	3.41 (2.06 to 5.65)	<0.001
Cardiac failure	2.85 (1.52 to 5.35)	0.001
Male sex	2.02 (1.37 to 2.98)	<0.001
Type 2 diabetes	1.84 (1.24 to 2.73)	0.002
Overweight/Obese	1.58 (1.02 to 2.46)	0.04
Increasing age	1.06 (1.04 to 1.07)	<0.001

COPD, chronic obstructive pulmonary disease; SLD, structural lung damage; TB, tuberculosis.

opened in June 2020, the last month of this study period. At the field hospital, care might include management of comorbidities, palliative care or further recovery prior to discharge home.[17]

The differences between RHS and MHS appeared to represent differences in the type of patients and geographic access rather than health services. RHS appeared to have younger patients, more often referred by local primary care facilities, with fewer comorbidities and less severe disease, which translated into lower mortality

and better outcomes. In the Western Cape, the rural district hospitals had good infrastructure, equipment and competent clinical teams led by family physicians.

No other studies were found reporting on district hospitals from low-income and middle-income countries. The few studies from the UK reporting on district hospitals are not comparable as these hospitals offer specialist services and serve a different type of population.[18] District or primary hospitals in our setting are small, often rural or remote, and led by generalists or family physicians. These types of hospitals are rare in high-income countries, but an important part of African health systems. Although district hospitals in the Western Cape are generally well resourced and led by family physicians, in other parts of Africa these hospitals may have significant skills, equipment and infrastructure gaps.[19] African populations are also younger and have a different profile of comorbidities with communicable diseases more prominent (such as HIV, TB and malaria). Poverty is also a major issue that impacts on access to healthcare as well as food security and malnutrition.[19] It is therefore important to evaluate how people with COVID-19 are managed and what their outcomes are at this level of African health systems.

Management of COVID-19 at district hospitals

Patients presented with the typical symptoms of COVID-19 that have also been reported elsewhere in Africa.[20] Fever, however, was only found in 12% of patients and many patients had hyperglycaemia and high blood pressure, reflecting underlying comorbidities. Family physicians reported that the procedures to use infrared thermometers to triage patients may not have resulted in accurate measurements and therefore fever may be underobserved.[21] Not all patients had a body mass index measured and overweight/obesity was probably under-reported.

As the median TOT for COVID-19 tests was longer than the median length of admission, most patients were managed as people under investigation, who were presumed to have COVID-19. The laboratory capacity and TOT for COVID-19 tests has been labelled 'the Achilles heel' of the local response to the pandemic.[22] The in-hospital TOT improved once the criteria for community testing were changed, from all people with relevant symptoms to only those over 55 years or with comorbidities or with more than mild disease.[23]

Antibiotics were presumably given as the diagnosis was not confirmed in the majority of patients and the patient were treated as a community-acquired pneumonia with COVID-19 as part of the differential diagnosis. Steroids were only given in 28% of patients, but the evidence of their effectiveness were only announced in June 2020,[24] which was the last month of this study period.

Basic imaging with a chest radiograph was only performed in half the patients, which mirrors the large number of mild cases who did not require imaging. All district hospitals had access to radiography, although not always 24 hours a day and in some cases the clinician may have judged that management of the patient would

not be changed. In addition, radiography might have been avoided in order to reduce exposure of people to COVID-19 as patients would have to traverse the hospital to access the radiography unit if a mobile radiograph was not available. Not all critically ill received a radiograph and this might be because they died before a radiograph could be taken or were transferred. Patients were referred on the basis of the clinical picture and a radiograph was not essential.

Clinical outcomes at district hospitals

Overall in-hospital mortality for COVID-19 was 11% and rose to 20% in those admitted. Mortality was significantly higher in MHS facilities compared with RHS and this most likely reflects the higher severity of patients, rather than differences in management of patients. Mortality rates reported from a field hospital in Ethiopia were much lower (5.3%) despite a similar profile of COVID-19 severity in those seen.[25] This may be explained by much lower levels of comorbidity. For example, no HIV or TB was reported and diabetes was found in 14% as opposed to 25% of patients.

A local population cohort study also found an association between people living with HIV and mortality from COVID-19 and no clear association with viraemia or immunosuppression.[26] However, in district hospitals we found no association with previous or current TB infection and mortality from COVID-19, while the population cohort study found a twofold increase. The population study may have overestimated risks as routine data did not include all comorbidities and these patients were more likely to be followed up and diagnosed with COVID-19. Other respiratory conditions such as asthma, COPD and post-TB structural lung disease were also not associated with increased mortality. This could suggest that immunological factors were maybe more important than pulmonary factors in determining risk of death. Other conditions with impaired or altered immunity were also associated with mortality, such as type 2 diabetes and people receiving treatment for cancer.

The combination of increasing age, overweight/obesity, type 2 diabetes, chronic kidney disease and cardiac failure as independent risk factors is important as one in two South Africans over the age of 45 years have prediabetes or diabetes.[27] Increasing age, obesity and chronic kidney disease were also identified as key risk factors in the Democratic Republic of Congo[28] and diabetes in Ethiopia. The importance of non-communicable diseases, such as diabetes, was brought into the public spotlight by COVID-19 as previously the focus of attention was on HIV and TB. The level of control of diabetes was also directly related to risk of mortality, which emphasised the need to improve self-management and treatment, particularly as 57% had a history of poor control on admission. The absence of electronic medical records and an integrated health information system explains why hospitals could not obtain information on prior control of chronic diseases, particularly in the RHS. The continuity of care

for type 2 diabetes was also disrupted by the de-escalation of services and most forms of patient education and counselling were stopped. There is a need to innovate new ways of managing and empowering people with diabetes while reducing their risk of exposure to COVID-19 at health facilities and support groups.

All results were dependent on the completeness and accuracy of medical records. For example, clinicians may not have recorded all the symptoms experienced by the patients. Family physicians did not report a problem with missing medical records. It would have been helpful to record the antiretroviral treatment regimen in patients with HIV and to investigate any association between mortality and exposure to different combinations of medications. No data were collected on laboratory results such as full blood count, urea or creatinine or on the time between onset of symptoms and treatment, and this might have been useful to investigate the relationship with clinical outcomes. It was not possible to determine the outcomes of patients that were discharged from the EC with mild disease and it is possible that some were re-admitted to other hospitals. None of the family physicians collecting data reported that patients in the study were re-admissions.

These hospitals all had family physicians heading their clinical teams and it is possible that they had a higher quality of care than the hospitals that are still without them. The Western Cape also has better infrastructure and a stronger health system than many other provinces and the quality of care is likely to be lower in other parts of South Africa.

CONCLUSIONS

District hospitals provided an essential primary care service for many patients with mild symptoms of COVID-19 during the epidemic. This also represented a deficiency in access to and utilisation of primary care. District hospitals successfully treated a large number of people with moderate-to-severe COVID-19 who did not need ventilation and took pressure off higher-level facilities. Limited laboratory capacity meant that most patients were treated as people under investigation without a definitive diagnosis. The clinical picture was similar to that reported elsewhere. Mortality at this level of care was associated with increasing age, male sex, HIV, type 2 diabetes, overweight/obesity, cardiac failure, chronic kidney disease and treatment for cancer, but not with hypertension, TB, asthma, COPD or post-TB lung damage. Patients in the MHS were more numerous, had more comorbidity and more severe COVID-19 disease than in the RHS.

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