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WAVE 2

National Income Dynamics Study (NIDS) – Coronavirus Rapid Mobile Survey (CRAM)

Examining the unintended consequences of the COVID-19 pandemic on public sector health facility visits: The first 150 days

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Examining the unintended consequences of the COVID-19 pandemic on public sector health facility visits: the first 150 days

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Abstract

This paper considers how access to public sector healthcare in South Africa have been affected by the COVID-19 pandemic using three sources of evidence: the NIDS-CRAM (Coronavirus Rapid Mobile Survey) and MatCH (Maternal and Child Health) SMS survey together with routine health care utilisation data from the District Health Information System (DHIS). Our analysis shows that across almost all districts in the country there was a reduction in primary healthcare utilisation, especially in HIV testing and health visits by children under 5 years of age, irrespective of the actual district-level incidence risk of COVID-19 at the time. Preventive services such as immunisation and contraception were still below expected levels in 75% of districts in August 2020. These unmet needs are corroborated by survey results for the uninsured segment of the population where 23% reported not seeking acute care when needed and inability to access medication, contraceptives or condoms. HIV testing is climbing again in some areas, and early access to antenatal care was only slightly lower than expected, recovering quite quickly since April 2020. COVID-19 fears may have disproportionately affected the poorest and most vulnerable groups, and impacted access especially to preventive services, where the negative consequences may unfold over an extended period if interventions to 'catch up' are not urgently prioritised and closely monitored.

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Executive Summary

This policy paper examines the unintended health consequences of the COVID-19 pandemic in South Africa. We consider how the virus and the government's response to its outbreak have affected access to health care and treatment using three sources of evidence: the unique Maternal, Adolescent and Child Health (MatCH) and NIDS-CRAM data sets (developed to consider the adverse social and health effects of the pandemic), as well as routine healthcare utilisation data from the District Health Information System (DHIS). Specifically, we consider access to acute and chronic care among the general population with our NIDS-CRAM data set, and access to antiretroviral therapy (ART), vaccinations and care by mothers – pregnant women and women with infants who use public sector health services – with our MatCH data set. Key healthcare utilisation indicators were extracted from the DHIS from January 2018 to August 2020 to detect changes in healthcare utilisation. We find that there were significant unintended consequences of COVID-19, but these consequences varied based on the type of care and the patient group.

Analysis of routine healthcare utilisation data from the DHIS revealed that the pandemic had a substantial and enduring impact on healthcare utilisation observed during April and May 2020 (when 'hard' lockdown regulations were in force nationally), with a dramatic impact on total and under 5 Primary Health Care (PHC) utilisation, as well as HIV testing. By contrast, early access to antenatal care was only slightly lower than expected and recovered quite quickly after April 2020.

Facility visits (as measured by PHC utilisation (total) and PHC utilisation, for under 5s), immunisation coverage, and couple year protection rate (contraception delivery), are still below their pre-pandemic levels in 75% of districts in August 2020. Overall, we see a slow recovery for healthcare utilisation.

The analysis of our MatCH survey of public sector mothers found that:

- One in six (16.67%) of the mothers and pregnant women reported having last visited a hospital and a clinic in April or earlier, representing a two-month gap in care, which is considered to be a risk for this group. However, this risk would admittedly vary substantially based on the individual's health. Pregnant women are advised to visit the clinic every six weeks.
- Based on evidence of missed or delayed vaccinations, one in four women whose babies needed key vaccinations over the past two months have not been to the clinic during that period.
- One in 10 (11%) mothers and pregnant women living with HIV ran out of antiretroviral therapy (ART) medication.

The analysis of our NIDS-CRAM survey of the South African population found that:

- More than one in five (23%) of the uninsured survey sample reported that they could not access medication, contraceptives or condoms over the past four weeks.
- Of the uninsured respondents who needed acute care, 23% did not seek care.
- Of the uninsured respondents who needed chronic care, 4% did not seek care.

Overall, we found that a very large share of unmet healthcare needs is attributed to COVID-19 fears, indicating that the pandemic has had considerable unintended public health consequences. There is also evidence of some protective effect of affluence, which may partly operate via access to medical insurance. We also found that COVID-19 fears are more of an impediment among the poorest and most vulnerable groups.

We consider these estimates to be conservative because we focus on high-stake types of health demand. Given the risk of ART interruptions for pregnant and breastfeeding mothers, we would expect this patient group to be less likely to run out of ART than other patients. While both surveys benefited from large and well-represented sampling frames and careful stratification, non-response bias remains a risk, especially with telephone and SMS surveys where non-response is known to be higher.

Policy recommendations centre on:

- exerting less control and ensuring more co-ordination;
- understanding the cost of using fear to motivate behaviour change;
- improving access to preventative care, screening and contraception through expanding distribution points for contraception beyond the PHC facility and increasing self-testing and the use community-health workers;
- expanding the range of alternative mechanisms to access medications; and
- establishing a helpline *for at-risk patients who run out of medication.*

Introduction

Health systems globally are being challenged by increasing demand for care of COVID-19 patients, over and above the need to protect at-risk populations and to address their existing burden of disease. The COVID-19 pandemic has had a significant impact on the capacity of health systems to continue the delivery of essential health services. As at 20 November 2020, South Africa had recorded a cumulative number of detected COVID-19 cases of 757 144 out of a total of 5 189 580 tests conducted, and a total recovery rate of 93% (701 534). The total number of COVID-19-related deaths was 20 556 at this date.[2]

Evidence from past pandemics indicates that resources are diverted from routine health services, especially for women and children, to deal with pandemic care. The indirect health costs of these actions can be of a similar magnitude to the direct health costs of the epidemic itself. During the Ebola pandemic in West Africa, there was a sharp decline in the utilisation of antenatal and postnatal care. Women had limited access to (already limited) sexual and reproductive health services, which resulted in a spike in stillbirths and the deaths of mothers, neonates and children from health issues not related to Ebola (Ribacke, et al., 2016; Sochas, Channon and Nam, 2017). Limited sexual and reproductive health services could also lead to an increased number of unsafe abortions performed. Focusing on only the healthcare outcomes does not fully take into account the social and economic costs of, for example, unplanned children.

South Africa faces a quadruple burden of disease resulting from communicable diseases such as HIV/AIDS and tuberculosis (TB); maternal and child mortality; non-communicable diseases (NCDs) such as hypertension, cardiovascular diseases, cancer, diabetes, mental illnesses and chronic lung diseases like asthma; as well as injury and trauma. Evidence in the local media points to a negative impact of COVID-19 on healthcare utilisation for HIV/AIDS, TB and maternal and child health services (Beker, 2020; Kahn, 2020; Mbovane, 2020; Ellis, 2020; Penfold, 2020).

Impact of the epidemic on adherence to treatment and testing for communicable diseases

According to narratives that surfaced in media reports in May, Gauteng Province said that during April, close to 11 000 HIV patients had failed to collect their medicines since the start of the 'hard' lockdown period (Shange, 2020). At the same time, Professor Francois Venter, an infectious diseases doctor at Wits University's Faculty of Health Sciences, reported that headcounts at Johannesburg clinics had decreased by between 30% and 70% since the onset of the COVID-19 pandemic (Cullinan, 2020). However, these declines in utilisation may have been from clinics that experienced 'worst-case scenarios' and therefore not representative of national trends.

Since the start of lockdown in South Africa, the National Institute for Communicable Diseases (NICD) has released two reports on the impact of COVID-19 on TB services. An earlier report concluded that Level 5 lockdown restrictions caused a 48% decrease in TB testing volumes, and that laboratory-confirmed TB cases contracted by 34% compared to the same period in 2019 (NICD, 2020). As the pandemic has continued and lockdown restrictions have eased, a large impact on GeneXpert TB tests have remained; Moultrie et al., (2020) find that, in comparison to forecasts for these tests

2 https://mediahack.co.za/datastories/coronavirus/dashboard/

for April to July, there have been 309 000 fewer Xpert tests, 17 700 fewer positive tests, and 540 fewer rifampicin-resistant tests. The authors conclude that the continued lower levels of both overall test numbers and positive tests could best be explained by a combination of patient and health system factors [decreased movement of people and fewer accessing health care (NICD, 2020)]. An increase in the Xpert positivity rate from around 7% in March to 10% between April and July suggests that people delayed seeking care and often sought testing only when they experienced more intense TB symptoms (Moultrie, et al., 2020).

Continuity of both access to diagnosis and treatment for communicable diseases, especially HIV and TB, is essential to avoid eroding the progress that has been made in containing these diseases. A recent paper weighing the overall health benefits of pre-exposure prophylaxis (PrEP) provision and HIV risk-reduction counselling for HIV-uninfected pregnant and breastfeeding women (relative to COVID-19 infection risks), found that the benefits of these services far outweigh the infection risks associated with COVID-19 (Davey, et al., 2020).

World Health Organization (WHO) and UNAIDS (2020) models estimate that unless there are effective interventions, the COVID-19 response in sub-Saharan Africa could lead to a six-month disruption of ART, which could cause up to 500 000 additional deaths from AIDS-related illnesses. As far as we know, there are no comparable models focussed solely on South African HIV trajectories.

Impact on maternal and child health

One of the types of healthcare hardest hit by the pandemic is access to contraception (reproductive healthcare) and preventative care for children in the form of immunisations and post-birth visits. At a global level, it has been estimated that the percentage of women of reproductive age who would have had their need for family planning met through modern contraceptive methods in 2020 will fall from 77% to 71% (Dasgupta, et al., 2020). This implies that there will be approximately 60 million fewer users of modern contraceptives in the world in 2020 (Dasgupta, et al., 2020). Estimates provided by the Marie Stopes International (MSI) network across 37 countries indicate that 9.5 million women and girls have lost access to contraception and safe abortion services in 2020 through their network alone, potentially resulting in 2.7 million unsafe abortions and 11 000 pregnancy-related deaths (Cousins, 2020). As far as we know, there are no such estimates specifically for South Africa.

In South Africa, an analysis of routine data on contraceptives dispensed in the public health sector in Gauteng shows decreases occurring both in the two months before and during lockdown (Adelekan, et al., 2020). The decreases in provision of hormonal injectables and increased prescription of oral contraceptive pills just before the lockdown, could be due to pre-lockdown bulk stock, or a preference of health care to avoid close contact with patients. The authors attribute the persistent under-utilisation of the intra-uterine contraceptive device, hormonal implants and sterilisation to a combination of supply challenges, restricted access to other choices, and limited options provided to women, and they recommend further research to examine this.

These findings align with projections from Roberton, et al. (2020), who modelled the impact of reductions in healthcare access under three scenarios in low-and-middle-income countries during the COVID-19 pandemic. The scenarios range from minor disruptions to health workers and supplies, to major disruptions and also restrictions on individual movement, and the authors tracked the impact on each of the 118 lower- and middle-income countries. They found that the indirect impact of the pandemic on individual countries could cause a 9–45% increase in monthly under five child deaths and an 8%–39% increase in monthly maternal deaths.

A recent WHO survey of 105 countries showed that 70% of countries experienced disruptions to their routine immunisation services, and 61% experienced disruptions to their facility-based services due to COVID-19. Disruptions in non-communicable disease diagnosis and treatment, antenatal care and cancer diagnosis and treatment was reported by 69%, 56% and 55% of surveyed countries respectively (WHO, 2020a).

The WHO reported in April that 24 countries had delayed measles immunisation for children since the outbreak of COVID-19. This leaves more than 117 million children at risk of not receiving this life-saving vaccine if COVID-19 continues to spread and no recovery plans are implemented to address this delay (WHO, 2020b).

The benefits of sustaining child immunisation during the pandemic have been calculated through high-impact and low-impact scenarios relative to the risk of a child dying from COVID-19. Although the results are driven by strong assumptions, having at least two scenarios allows for the estimation of a range of possible impacts (Abbas, et al. 2020). Even in a low-impact scenario, it is estimated that the benefit-risk ratio (benefits relative to COVID-19 infection risk) to households of vaccinated children (as prevention of measles outbreaks) is 3, and if the benefit for children only is considered, the benefit-risk ratio is 3 000 (Abbas, et al., 2020).

Across countries, there is a strong pattern of delayed or missed antenatal care appointments being associated with an increase in stillbirths (Ashish, et al., 2020; Watson, 2020). In Nepal, the institutional birth rate decreased by more than half and there were increases in the institutional stillbirth rate and neonatal mortality (Ashish, et al., 2020). Measuring the impact of antenatal care appointments in terms of stillbirths is a short-term outcome. Over the medium term, for children who are born after missed antenatal care appointments, there may be weaker health and development outcomes not fully accounted for by short-term focused research.

Impact on curative services

In addition to HIV/AIDS and TB, and maternal and child health, life-saving curative health services provided in hospitals have also been disrupted by the pandemic. Unique data and evidence from India showed a 64% increase in mortality among dialysis patients between March and May 2020, with a further estimated 22–25% excess mortality in this group to July 2020 (Jain and Dupas, 2020). The mortality increase was found to be greater among women and more vulnerable individuals. The changes have been ascribed to barriers to transport and disruptions in hospital services.

An analysis using retrospective data, comparing the pre-lockdown period from 3 February to 26 March 2020 and the initial stage of lockdown from 27 March to 30 April 2020, found decreases in most types of surgeries at a tertiary healthcare complex in North West Province in South Africa (Moustakis, et al., 2020). While the reduction of 53% in the incidence of trauma-related admissions can be explained by less movement of people and a reduction in alcohol-related admissions due to the pandemic-related alcohol ban from 27 March until 1 June, there was also a reduction of 44% in non-trauma admissions.

Avenues of influence: unintended public health consequences

The unintended consequences of the COVID-19 pandemic could operate via demand-side and supply-side factors.

Demand-side factors

On the demand side, fear of the virus and infection has been a frequent theme in the postponement of both chronic and acute care, in South Africa and globally. One of the main channels has been disruption or restriction of travel and movement – especially in the early phases of the pandemic, during the hard lockdown. For instance, the reduction in TB testing, discussed earlier, has been ascribed to decreased movement of people and reduced access to health care (NICD, 2020). During the early stage of the Level 5 lockdown, there were severe constraints on movement – with exceptions made mainly for essential work, grocery shopping and health visits. These rules were enforced locally by police and deployed military staff, with the media reporting numerous claims of brutality and abuse of power.[3] Even though travel for health reasons was allowed, patients may have feared that they would not be able to verify this reason for travel and may not be believed.

3 Haysom (2020) reported that that 230 000 people were arrested and 11 people were killed during the first five weeks of the hard lockdown.

Additionally, public transport and taxi services were disrupted during the hard lockdown period due to restrictions on their operating hours and carrying capacity. There were media reports of taxis not being available for travel or being prohibitively expensive because prices had escalated to a multiple of pre-lockdown fares (Masweneng, 2020). At the same time, the ability to pay for travel would have been affected by the loss of employment and income sources during the lockdown (Jain et al, 2020).

Additionally, given the evidence on large-scale job loss and increased hardship, it is plausible that visits to health facilities may have been affected by competing – or in case of treatment, complementary – priorities such as food and hunger (Torlutter, 2020).

National data suggest that one in 20 South Africans moved between provinces during the hard lockdown period (Posel and Casale, 2020). This would also have affected access to care and continuity of care.

There may also have been positive unintended consequences. School closures may have generated short-term reductions in paediatric infections. There was also less movement and travel overall during this period, which would have reduced exposure to many infectious diseases. San Francisco, USA, experienced a decline in the number of reported gonorrhoea cases among the male gay community after the outbreak of the HIV pandemic, while in Mexico, during the 2009 outbreak of influenza (H1N1), the country saw a decline in the diarrhoea-related deaths among young children (Aguero and Beleche, 2017). Some potential positive effects that may emanate from the COVID-19 pandemic include a reduction in various viral infections and gastrointestinal diseases due to increased hand-washing. There was a sharp decline in influenza cases during the winter of 2020 (Olsen, et al., 2020). If a share of the improvement in hygiene and awareness is sustained, it may generate long-lasting positive decreases in communicable diseases.

Lastly, the ban on alcohol may have had a positive effect on healthcare utilisation. The sale of alcohol was banned in South Africa from 27 March until 1 June and then again from 12 July to 17 August as part of the COVID-19 response. Barron et al. (2020) find that the alcohol ban resulted in a 14% drop in deaths due to unnatural causes.

Supply-side factors

There are also concerns about supply-side effects, some being attributable to proactive prioritisation and planning and therefore not easily defined as unintentional. A shift of resources has also been observed since the beginning of the national response to COVID-19, as some existing hospital wards for acute or other care have been converted for COVID-19 care. For example, some of Tygerberg Hospital's TB wards were converted into COVID-19 wards (Steyn, 2020). If there is decanting of patients due to the use of new avenues or methods for home deliveries of medicines (Brey et al., 2020) or allowing patients on chronic medication to be issued a two-month supply of medicine, this will also affect patient volumes and routine data. Deliberate policy decisions were made to ensure the availability of health staff for COVID-19 patients and other patients requiring critical emergency care, and also to free up facility space for COVID-19 patients. In terms of hospital bed availability, the decision taken was that only maternity beds would not be reduced (or set aside for COVID-19) but all other beds were prioritised for COVID-19 patients. At primary care level, efforts were made to decongest clinics and limit services.

Supply-side effects can, however, also occur unintentionally. In some cases, clinics were closed for cleaning because staff had contracted the Coronavirus or had been in close contact with COVID-19 cases (Torlutter, 2020). Small clinics can be closed if all nurses contract COVID-19. Non-COVID-19 patients may also be crowded out because of greater demand for available clinical time and hospital beds.

Indirect channels

These demand- and supply-side factors mostly highlight the probable drivers of individuals' interactions (or lack thereof) with the health system, which is the focus of the paper. However it is worth point out that COVID-19 may also impact health status indirectly through channels that do not run through the health system but that are more specific to the individual's experience of the pandemic and associated lockdown approaches.

Pandemics and unprecedented natural disasters can have longer-term effects on the mental health status of individuals. In a vulnerable sample of low-income mothers in New Orleans (using longitudinal data), it was found that both mental and physical health deteriorated for up to one year after the Hurricane Katrina disaster, with some effects persisting for as long as 12 years after the event (Raker, et al., 2020). Similarly, there is evidence that earthquakes may affect the birth weight of babies via its impact on maternal stress (Menclova and Stillman, 2020).

We know that health is affected by social circumstances and social circumstance have been impacted dramatically by the lockdown, specifically with a loss of almost three million jobs, and the resulting hardship and hunger in South Africa (Jain et al., 2020; Spaull, et al., 2020). Other important indirect issues to consider include loss of education and the reported increase in gender-based violence.

Lastly, there are larger resourcing and health system effects that should be noted but would be premature to discuss. Due to the large fiscal expenditure associated with the COVID-19 response, the pandemic may generate longer-term resourcing effects. It may move funding away from South Africa's typical critical burden of disease areas towards COVID-19 infection control and greater hospitalisation capacity. Although the emergency budget has made provision for additional COVID-related health expenditure, it is not yet clear how resourcing decisions at provincial level will be affected over the next two to three years. Similarly, policy makers have expressed the hope that the greater co-ordination, trust and information-sharing required between levels of the health system and the private and the public sector may yield long-term benefits, but it is too early to know whether these effects will be sustained.

Data

We have access to three large data sets to consider how care and treatment have been affected by the pandemic. Two of these – National Income Dynamics Study Coronavirus Rapid Mobile Survey (NIDS-CRAM) Wave 1 and a Maternal, Adolescent and Child Health (MatCH) survey of MomConnect mothers – are unique datasets designed specifically to answer these questions. Results from Wave 1 of these surveys have been previously reported. In this update report, we combine these results with an analysis of routine healthcare utilisation data from the DHIS.

The following section provides more information on the DHIS, NIDS, NIDS-CRAM and MatCH SMS survey. These data have been combined with Statistics SA Census 2011 data to create poverty quintiles for mothers in the MatCH survey. We describe the matching to the Census, but do not provide more information on this well-known data source because it is not central to this analysis.

Permission was granted by the National Department of Health to survey their patients and to analyse the monthly DHIS data for consequences of the pandemic. Ethics approval for this work was obtained from the University of Stellenbosch Research Ethics Committee for Social, Behavioural and Education Research [Project 14926 on 15 June 2020] as part of the rapid Coronavirus research stream.

Routine health services data

Within the public sector, the DHIS collects aggregated routine data from Primary Health Care (PHC) facilities and hospitals to support decision-making and health service management. The DHIS was introduced in South Africa in 1996 and was extended to the entire country by 2001. Data collection uses the DHIS2 web-based platform developed by the Health Information Systems Programme (HISP) and used across several countries (Williamson, Stoops and Heywood, 2001; Garrib, et al., 2008; Farnham et al., 2020).

The reporting of routine data through the DHIS is informed by the National Indicator Data Set[4], which is defined by the National Health Information System of South Africa Committee (which includes the National and Provincial Departments of Health). The NHISSA Committee makes recommendations about updates to the data set and the National Health Council Technical Committee (comprising Heads of Departments) approves the NIDS.

The DHIS predominantly records routine data generated at facility level, but also includes exports from the disease-specific electronic registries established for the Three Integrated Electronic Registers (TIER.Net) HIV and tuberculosis control programme. Other routine data are gleaned from the financial management Basic Accounting System (BAS), the human resources Personnel Administration System (PERSAL), the National Health Laboratory Service (NHLS), and medicines procurement and distribution systems.

As personnel data are not routinely reported by district, public sector human resource data for the key professions (Medical Practitioners, Professional Nurses, Pharmacists) were extracted up to 2020 and subjected to an extensive data-coding process to identify occupational classifications and geographic location (health facility/district) (Day, Gray, Ndlovu and Cois, 2019). Data on provincial and local government expenditure on health were extracted from National Treasury data sources and coded to district level. Indicators of expenditure per capita and per PHC headcount were calculated using expenditure from selected budget sub-programmes within the District Health Services programme, modelled estimates of the uninsured population, and routine data on headcounts, as described in the annual District Health Barometer (Massyn, Barron, Day et al., 2020). Socio-economic quintiles were derived from the South African Index of Multiple Deprivation (Noble et al., 2013) and adapted for the District Health Barometer (Gaede and Eager, 2014).

The selected DHIS indicators are: the Primary Health Care (PHC) utilisation rate (total and for children under 5 years); immunisation coverage for infants under 1 year; the proportion of first antenatal care visits that occurred before 20 weeks of pregnancy; the total number of HIV tests performed; and the couple year protection rate (CYPR) as a measure of contraception delivery. The inpatient bed utilisation rate and patient day equivalent are included as measures of inpatient utilisation. Definitions of each indicator are provided in Appendix Table 1. Monthly data for key healthcare utilisation indicators were extracted from the DHIS, across all districts, from January 2018 to August 2020.

Data to assess clinical risk due to COVID-19 were obtained from the district and sub-district data sets manually compiled by MediaHack[5] based on statistics published by the nine provincial governments. All laboratory-confirmed cases of COVID-19 are legally required to be reported to the NICD in terms of the Notifiable Medical Conditions regulations.[6] Incidence risk was then calculated as the number of cases per population by time period for each district.

NIDS-CRAM Wave 1, 2020

CRAM is a national survey of 7 074 adults drawn from the National Income Dynamics Study (NIDS)[7] Wave 5 sample. NIDS is a national panel study that has been following the lives of the same 28 000 South Africans (and those with whom they live) every two years since 2008. NIDS was founded and is managed by the South African Labour Development Research Unit (SALDRU) at the University of Cape Town. As the NIDS Wave 5 sample has endured four rounds of attrition since the first draw in 2008, it has consequently become increasingly less representative of South Africa over time.

4 National Indicator Data Set data dictionary accessible online https://dd.dhmis.org and in a mobile app https://play.google.com/store/apps/details?id=za.doh.nids&hl=en_ZA

5 https://mediahack.co.za/datastories/coronavirus/data/

6 https://www.nicd.ac.za/nmc-overview/

7 Please note that the acronym ‘NIDS’ is sometimes used to describe the National Indicator Data Set that defines the indicators used in the DHIS. In this paper, the acronym is used to refer to the National Income Dynamics Survey.

Despite such caveats, using this sampling frame was the most feasible strategy given the restrictive parameters for research during the lockdown.

The NIDS-CRAM survey's first wave interviewed a subsample of adults from households in the NIDS Wave 5 between 7 May and 27 June 2020. The same group of individuals is telephoned each month and is asked a range of questions about their income and employment, their household welfare and receipt of social grants, and about their knowledge and behaviour related to COVID-19. This paper reports on the first wave, but there are at least three further waves planned.

The surveys are conducted as Computer-assisted Telephonic Interviews (CATI), in the respondent's preferred language. Each participant received a R20 airtime voucher per wave to thank them for participating. It should be acknowledged that the reliance on telephonic interviews will affect both how people respond to questions and their willingness to participate in the survey. However, given the parameters for surveys during the lockdown, these challenges will also be experienced in other surveys. A key advantage of NIDS-CRAM is the ability to model non-response using the rich information collected in the first five waves of NIDS. The aim of this survey is to provide inputs on key outcomes such as unemployment, household income, child hunger, access to government grants, and hunger. Wave 1 of the NIDS-CRAM survey included questions on access to chronic medication, chronic care and acute care. We also examine impediments to access through follow-up questions, which probe respondents about the reasons for their inability to access care. Potential answers included fears about arrest or fines; fears about contracting COVID-19; problems with transport availability; problems with paying for transport; and medicine stock-outs at the facility.

The NIDS-CRAM survey sample was obtained through a batch-sampling process of participants in the fifth wave of the 2017 NIDS survey. In 2017, this survey was broadly representative of adults aged 15 and older in South Africa. The batch-sampling process involved dividing the 2017 NIDS sample into 99 strata according to household per capita income decile, age, race and urban/rural place of residence. At first, a batch of 2 500 respondents, randomly drawn from the 99 strata, were approached to participate in NIDS-CRAM. Then, higher numbers of participants from strata with lower response rates were sampled, as were lower numbers from strata with higher response rates, until the final size was reached with equal representation from all strata. In total, 17 568 individuals were asked to participate, of whom 7 074 (40%) completed the questionnaire. The sample weight of individuals in NIDS-CRAM is a function of the corresponding 2017 NIDS sample weight and the sampling and response rates of each stratum in NIDS-CRAM.

Because the sample stratification was structured by the District Council, the data are not examined using provincial breakdowns. Rural–urban divides are also not considered in this analysis because of concerns about the reliability of these indicators in Wave 1 of the survey. An important caveat to interpreting the income quintile results is that the income variable was imperfectly measured, implying that one can calculate income quintiles for only two-thirds of the sample. All other analysis in this section uses the full NIDS-CRAM sample. Descriptive statistics for the NIDS-CRAM survey are presented in Appendix Table 3.

MatCH SMS survey Wave 1, 2020

The MatCH panel SMS survey (Coronavirus Rapid Mobile survey of maternal and child health) leverages the MomConnect mHealth platform, which has excellent coverage of pregnant women and new mothers. According to Lefevre, et al. (2018), in 2017, more than half of the women attending public sector antenatal care services were registered on the MomConnect platform. We drew a self-weighting sample of 15 000 pregnant women and new mothers from the database of MomConnect users who are either currently expecting or have had a child over the past year. The sample was stratified based on province, gestational age or age in months of their baby, and their type of phone.

All of the 15 000 women received an invitation to join the SMS survey on the afternoon of 24 June 2020. They could respond by SMS with 'JOIN' to participate in the survey, by sending an SMS 'STOP' to not participate, or to reply with 'MORE' if they needed more information. Those who participated in the survey received R10 in airtime. Assuming a response rate of 20% from the targeted sample of 15 000 women, we aimed to achieve a survey sample of 3 000 and realised a sample of 3 140, thus achieving an effective response rate of 21%. Descriptive statistics for the MatCH SMS survey are presented in Appendix Table 4.

The survey covers nutrition, depressive symptoms, access to antenatal care, vaccinations, and ART. As examined in the NIDS-CRAM, impediments to healthcare access were investigated by asking respondents who did not access care or collect their medicine to select the reason for non-attendance. Again, potential answers included fears about contracting COVID-19; problems with transport availability; long waiting times, and medicine stock-outs at the facility.

Poverty quintiles for all respondents were created by constructing poverty quintiles for all PHC public health facilities. Because of the focus on access to primary care and because the MomConnect mothers' registrations are lodged at their local PHC facility, only public sector facilities – clinics, community health centres and community day centres – were extracted from the government database of facilities. Each small area place in the Census was then linked to their closest public sector PHC facility, using the GIS codes in both the Census and the national facility database to create a catchment area for each facility. The poverty quintiles were estimated by deriving a measure of living standards and wealth measure via Principal Component Analysis (PCA), using employment status, education level, earnings category, household size, and cell-phone and car ownership. The component 1 scores are shown in Appendix Table 2. These scores were used to calculate wealth scores for each small area place in the Census and then aggregated over the entire catchment area, weighted by the population size. These wealth scores were used to calculate poverty quintiles. The sample of respondents in MatCH was matched to these poverty quintiles via the MomConnect facility-identifier, which identifies the facility where the mother was registered.

Methods

To answer this important research question of how healthcare utilisation has been affected by events associated with the pandemic, we draw on several data sources because we are aware of the blind spots of each individual data source. Declines shown by routine data may be exaggerated because we would expect the drop to be concentrated amongst those who can afford to wait or delay care or less crucial forms of care. Conversely, survey data on access to care is self-reported and often mediated by a question on health needs, which is very subjective and has been shown to be influenced by the time and financial costs of accessing care. We know that survey questions on access to care tends to underestimate unmet health care needs amongst the poor. Also, many services with high social benefit but low individual benefit may often not be categorised as health needs, including HIV tests or TB tests.

Additionally, social desirability bias may further amplify this downward bias: respondents (particularly expectant or young mothers) may under-report interruptions in their treatment and access to care, as there are strong social norms about the duty of care. Additionally, we should be concerned about our survey modalities and bias associated with these survey modalities. SMS and CATI surveys have lower response rates and may be affected by self-selection bias (based on unobservable characteristics). This could give a bias our survey findings.

For these reasons, triangulation is important. Routine data helps to anchor observations from survey data in large and national patterns. In turn, survey data add depth to the routine data as they provide granularity and give insight into the motivations behind decisions. This could help us understand why there may for instance have been a greater reluctance to consult healthcare workers or test for HIV.

In our selection of health services, we took account of five requirements: Firstly, we wanted to concentrate on services that are high volume. This is important both because it then affects more people, but also because the data would be more stable and more amenable to reliable district level analysis. This is even more important for the survey data where cell size always tends to be a challenge and is a particular headache in scaled-down surveys such as NIDS-CRAM and MatCH.

Secondly, we wanted to concentrate on services that are high impact and are likely to have long-term consequences like HIV tests and antenatal care. Thirdly, we needed to think about reliability, comparability and access. We could not get access to ART adherence routine data or TB data. Also, a number of DHIS indicators had definition changes that occurred at the time of the lockdown or were newly captured and did not have a long enough time series to enable robust comparisons over time. Fourthly, we also favoured DHIS healthcare utilisation indicators that corresponded most closely with the indicators of healthcare utilisation measured in our surveys. Lastly, we wanted the collection of indicators selected to cover a broad enough base so that there would be no obvious important omitted dimensions of healthcare.

The time periods covered by these three data sources are roughly comparable, as shown in the following table (Table 1). Our primary interest is in the period where the impact was the worst, namely the "hard" lockdown months of April and May 2020. Across all three data sources, the period assessed corresponds roughly to lockdown Alert Level 5 (27 March to 30 April 2020) and Level 4 (1 to 31 May 2020). We consider the trajectory of the decline and examine the recovery of service utilisation by July and August.

Table 1: Time period covered by DHIS data, NIDS-CRAM Wave 1 and MatCH SMS survey

	Data collection period	Time period assessed
NIDS-CRAM Wave 1	7 May and 27 June 2020	7 April to 27 May 2020 (four weeks prior to data collection)
MatCH SMS survey	24 to 30 June 2020	Month of previous clinic visit, April–June 2020 (vaccinations, child health). May–June (ART)
DHIS	January 2018 to August 2020	Depth of impact is observed by looking at utilisation during "hard lockdown" (April, May 2020), but observe recovery by analysing July & August

Descriptive analysis and visualisation of the DHIS data were used to assess the presence of time trends in the data, including discernible patterns of increase or decrease in utilisation over time, seasonality in utilisation, and peaks or troughs in utilisation in specific months. Graphs of monthly DHIS healthcare utilisation (shown in Figures 1–3, Figure 10 and Figures 13–14) show that, across all indicators, there is a decline in utilisation in December, during the annual holiday season. There was some evidence of seasonality in utilisation for some indicators. Mean utilisation rates for the selected indicators (shown in Appendix Table 5) suggest that, on average, there are substantial differences in healthcare utilisation between provinces. To test whether routinely reported healthcare utilisation declined during the lockdown period, the time trends, patterns of seasonality, and geographic differences in utilisation illustrated in these graphs should be taken into account.

Ordinary Least Squares (OLS) regression analysis was conducted on the pooled sample of selected monthly DHIS data to control for time trends, seasonality, and differences in healthcare utilisation across provinces and between metropolitan and non-metropolitan areas. In general, the fit of these regressions is good (as demonstrated by the R-squared value[8]). Regressions were run at district level, weighted by district population share.

Two sets of regressions were conducted. Firstly, regressions were run on the full sample of data (January 2018 to August 2020) to determine whether there was a discernible and significant change in utilisation in the two months of "hard lockdown" (April and May 2020). In Appendix Table 3 we examine whether declines in utilisation can be explained by less diligent data capturing by including indicators for data completeness and data timeliness (see definitions of these indicators in Appendix Table 1) in May 2018. These data quality indicators are collected and reported in all provinces, except the Western Cape.[9] It is encouraging that we do not see an increase in data incompleteness during the lockdown, and that the data incompleteness does not correlate with the size of the drop in utilisation (Appendix Table 6).

8 The fit of the regression for couple year protection rate is worse than for other utilisation indicators (as shown by the lower R-squared on this regression).

9 The regression shown here excludes the Western Cape, as a result.

Following from this, we proceed to estimate a second set of regressions on pre-lockdown time series data (January 2018 to March 2020). Out-of-sample projections of health care utilisation over the lockdown period were made and compared with actual observed utilisation (from April 2020 to August 2020). The difference between projected and observed health care utilisation gives an estimate of the magnitude of the decrease during the lockdown period. We benchmark these estimates to a comparison between the observed utilisation and its average historical levels in April and May 2018 and 2019. We use the similar approach to create an indicator of whether healthcare utilisation had recovered by July and August, analysing progress by recovery by district.

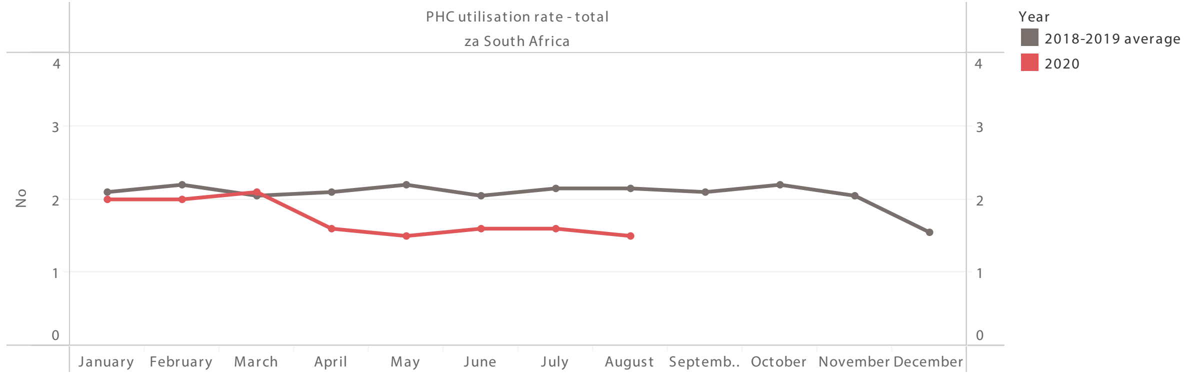
We complement this analysis with cross-tabulations from the two surveys. To ensure that our NIDS-CRAM analysis is comparable to public health facility visits documented in MatCH and DHIS data, the analysis focuses on the uninsured survey respondents (without medical schemes coverage).

Results

Acute and chronic care

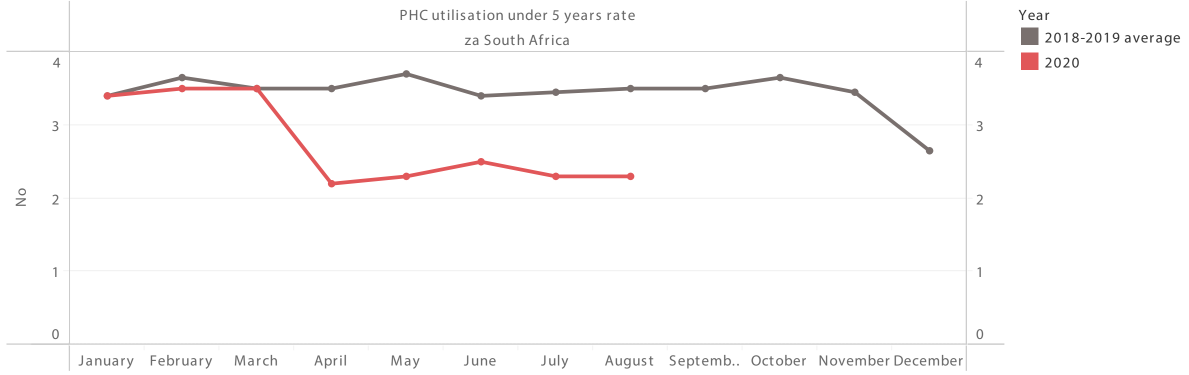
In the DHIS dataset, the PHC utilisation rate (total) and PHC utilisation rate (for children under five years old)[10] serve as broad indicators of PHC facility utilisation, regardless of the reason for healthcare-seeking. On average, the data show that between January 2018 and August 2020, the PHC utilisation rate (total) was 1.96 PHC facility visits per person per year. The mean rate was higher for children under five (3.26 visits per child per year). Figures 1 and 2 show that PHC utilisation for adults and for children under five declined in April 2020, when lockdown was implemented, rates and have remained low, even into August 2020. Graphically, the decline in PHC utilisation for children under five appears to be larger than that for the total population.

Figure 1: Primary health care utilisation rate (total), by month 2018 - 2020



Source: DHIS January 2018 to August 2020

Figure 2: Primary health care utilisation rate (patients under 5 years of age), by month 2018 - 2020



Source: DHIS January 2018 to August 2020

10 These indicators are expressed as numbers of PHC visits per person per year.

While graphical depiction of the data is useful and is suggestive of declines in utilisation in April 2020 (and continuing through to August 2020), regression analysis – which controls for geographic variation in utilisation, seasonality, and other variation in utilisation over time – can better isolate the decline in utilisation associated with the lockdown period. Our regression models in Appendix B show that there is a robust significant impact of the "hard" lockdown on healthcare utilisation. Having shown that there is a significant association between the "hard lockdown" months and reduced health care utilisation, we used a second regression technique to estimate the effect size of COVID-19 and lockdown on healthcare utilisation using the pre-COVID data to model the structure of healthcare utilisation prior to the pandemic and then create projections for April and May 2020 to compare to the observed actual utilisation for these months. These estimates are shown in Table 2 and in Figures 3 and 4.

Table 2: Estimated COVID-19 effect on healthcare utilisation

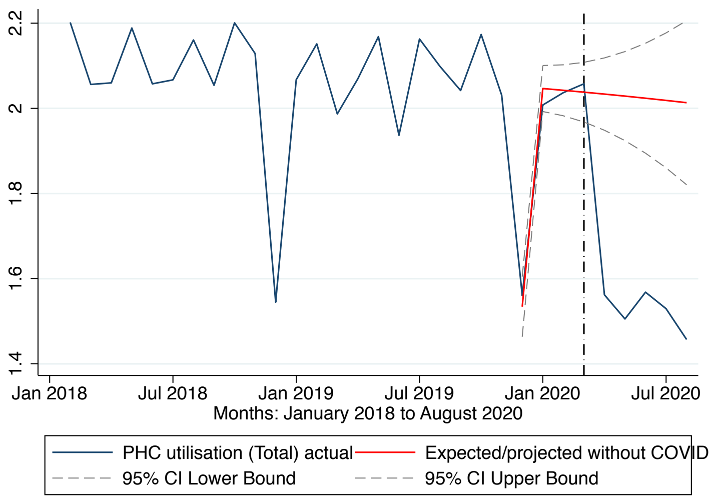
	Comparator			% change	
	Observed mean April and May 2020	**Projected mean April and May 2020**	**Expected: historical mean in April and May 2018 & 2019**	**Observed vs projected**	**Observed vs historical**
PHC utilisation rate (total)	1.53	2.03	2.12	-24.63	-27.83
	(0.06)	(0.06)	(0.05)		
PHC utilisation rate (under 5 years)	2.20	3.47	3.60	-36.60	-38.89
	(0.06)	(0.07)	(0.07)		
Immunisation coverage (infants under 1 year)	70.48	85.87	83.28	-17.92	-15.37
	(1.90)	(1.00)	(1.05)		
ANC 1st visit before 20 weeks rate	66.28	68.16	68.01	-2.76	-2.54
	(0.64)	(0.51)	(0.53)		
Couple-year protection rate	34.07	61.78	53.55	-44.85	-36.38
	(1.94)	(1.21)	(1.64)		
Total number of HIV tests ('000)	22.45	60.11	51.44	-62.65	-56.36
	(2.72)	(5.40)	(4.97)		
Inpatient Utilisation rate	57.09	72.15	74.00	-20.87	-22.85
	(1.60)	(1.33)	(1.07)		
Patient day equivalent ('000)	75.10	104.31	106.33	-28.00	-29.37
	(10.24)	(12.19)	(10.30)		

Data source: DHIS January 2018 to May 2020
Where: column 1 = indicator average for April, May 2020 for sum of districts weighted according to their population shares, column 2 = indicator projection based on model using data from January 2018 to March 2020 with out-of-sample projections for April and May 2020 [population share-weighted sum of districts]; column 3 = indicator average for April, May 2019 & 2018 for sum of districts weighted according to their population shares. Values in brackets are standard errors.

As shown in Table 2, in April and May 2020 the observed PHC utilisation rate (total) and for children under 5 years for April and May 2020 are significantly and substantially lower than these projected or expected rates based on patterns in the pre-COVID era. The observed PHC utilisation rate for all age groups and for children under 5 years in the months of hard lockdown are also significantly and substantially lower than those observed in the same months in the two previous years. The percentage change calculated in columns 4 and 5 provides estimates of the size of the impact of COVID-19 and the pandemic response on health care utilisation, total and for children under 5 years.

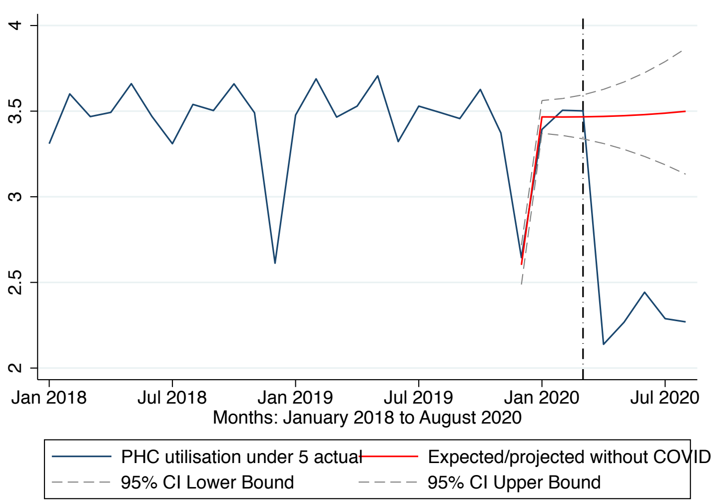
Figures 3 and 4 compare observed utilisation data for January 2018 to August 2020 (represented by the blue line) against projected utilisation for the months of April to August 2020 (based on the same regressions as Table 2, using data for the pre-COVID-19 period, up to March 2020). Projected utilisation for PHC utilisation (total) and PHC utilisation (children under 5 years) are represented by the red line. A 95% confidence interval for these projections is also shown in the graphs (by the dashed lines). These graphs suggest that observed PHC utilisation (total and for children under 5 years) in the presence of the COVID-19 pandemic is substantially and significantly lower than the levels projected (in a hypothetical no-COVID-19, no-lockdown scenario).

Figure 3: Observed PHC utilisation (total) vs pre-COVID projection



Source: Regression analysis of DHIS routine data (2018–2020).
Vertical dashed line represents April 2020 when lockdown was initiated.
Red line is projected utilisation based on a pre-COVID model

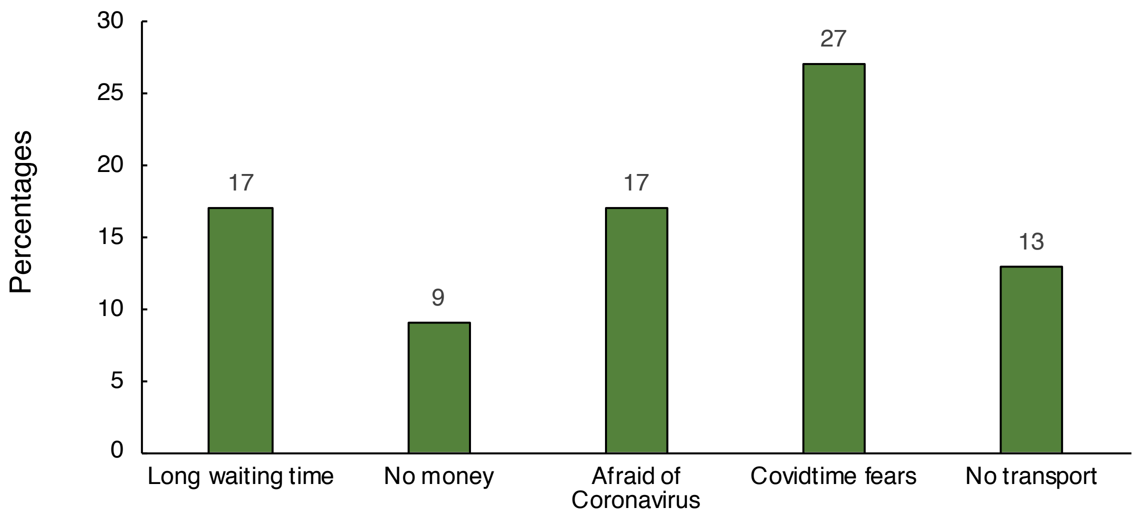
Figure 4: Observed PHC utilisation (under 5) vs pre-COVID projection



Source: Regression analysis of DHIS routine data (2018–2020).
Vertical dashed line represents April 2020 when lockdown was initiated. Red line is projected utilisation based on a pre-COVID model

The two surveys corroborate the patterns shown in the routine data, with respondents providing evidence of unmet health care needs in the lockdown period. According to the NIDS-CRAM dataset, almost one in 10 (9%) of uninsured respondents required acute health care over the four weeks prior to the study, reporting symptoms that, in their opinion, required attention[11]. Health needs for these questions were distilled by excluding those who said that they did not see a health worker because they did not require care for their symptoms, illness or injuries. Of the uninsured respondents who needed acute care, 23% did not visit a healthcare facility. Figure 5 illustrates the most frequently cited reasons for unmet healthcare for acute services; 27% of respondents attributed this to a Coronavirus-related fear (whether being generally afraid, afraid of being fined, or afraid of contracting COVID-19), and 17% said that they were afraid of the Coronavirus (a narrower subset of the preceding COVID-19-related fears category). Transport problems and a lack of money were also mentioned as reasons for not seeking health care – all worries that may also have been exacerbated by the COVID-19 pandemic.

Figure 5: Reasons for not seeing a health care worker when acutely ill [uninsured population]



Source: NIDS-CRAM Wave 1 (2020); data have been weighted.

Participants were also asked about access to chronic care during these times: 19% of uninsured respondents reported needing to see a healthcare worker regarding a chronic condition such as diabetes, TB, hypertension or HIV within the previous four weeks. Again, those who said that they did not consult a health worker because they did not need care were excluded. The majority of these chronically ill individuals did receive health care (96%). Among the 64 individuals who reported needing health care but not receiving it, the most prevalent reasons were COVID-19-related fears (29%).

Turning to the MatCH survey, 22% of households reported that a child in the household was either sick or in need of a vaccination. Of this group, 35 of 684 women (5%) who reported children in need of health care did not visit a health facility or worker. The low share of unmet need reported here may be due to the powerful, but subjective and social role of the term 'need'. Nineteen of the 35 women (54%) reported that they did not seek health care because they were afraid of contracting COVID-19.

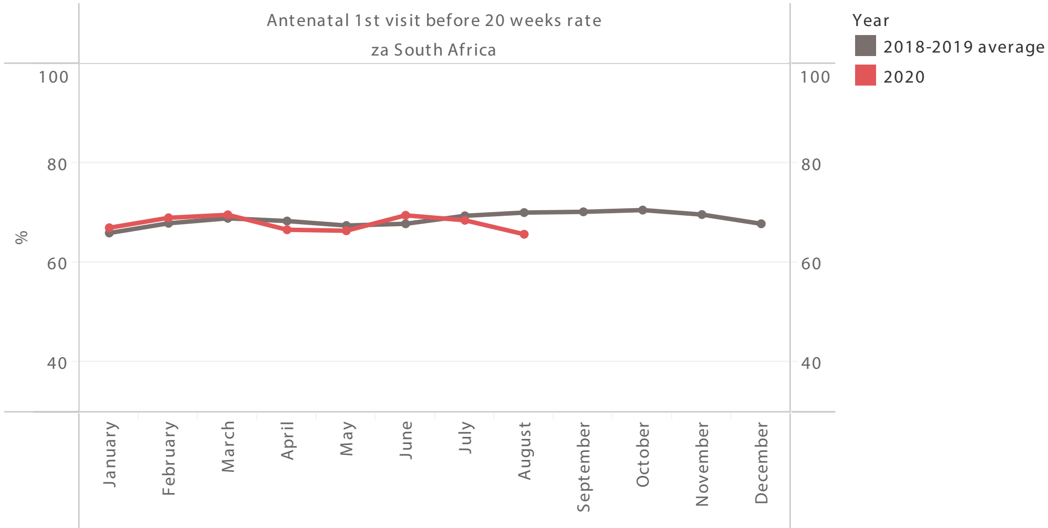
Healthcare visits by pregnant women and mothers with infants

Two measures of healthcare utilisation among pregnant women and infants were extracted from the DHIS data and analysed: immunisation coverage for infants under 1 year, and utilisation of early antenatal care (percentage of antenatal care 1st visits that occur before 20 weeks of pregnancy).

11 Respondents were broadly asked to report injuries or illness, but also specifically about fever, sore throat, coughing or shortness of breath.

The latter is a quality indicator for ANC which relates to rates of early access of ANC. It does not indicate ANC coverage overall. Figure 6 suggests that the decline in early access to ANC in April and May 2020 was relatively small and fairly short-lived. By June 2020, the proportion of ANC visits occurring before 20 weeks had recovered to 2018–2019 levels.

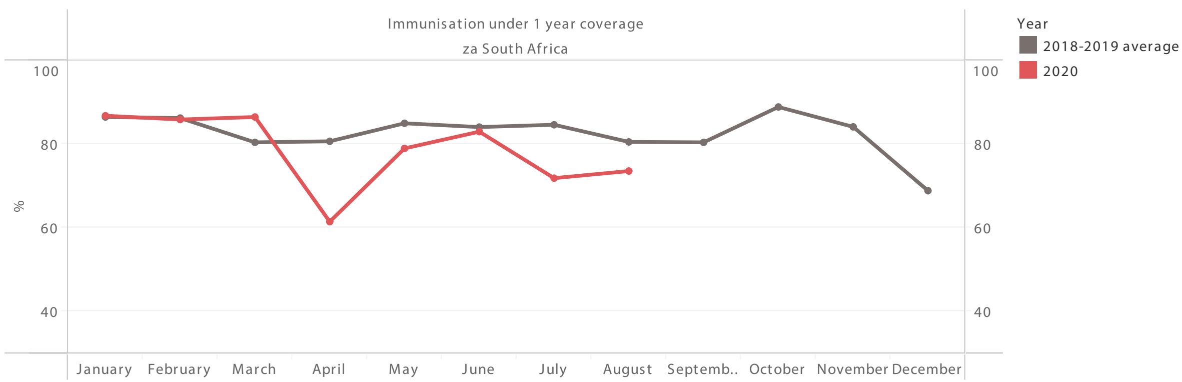
Figure 6: Antenatal care 1st visits before 20 weeks gestation, by month 2018 to 2020



Data source: DHIS (January 2018 - August 2020)

Figure 7 shows that immunisation coverage for infants under 1 year declined much more rapidly in April 2020, but began to recover in May. Mean immunisation coverage was 81.9% over the period January 2018 to August 2020.

Figure 7: Immunisation coverage for infants under 1 year, by month 2018 to 2020



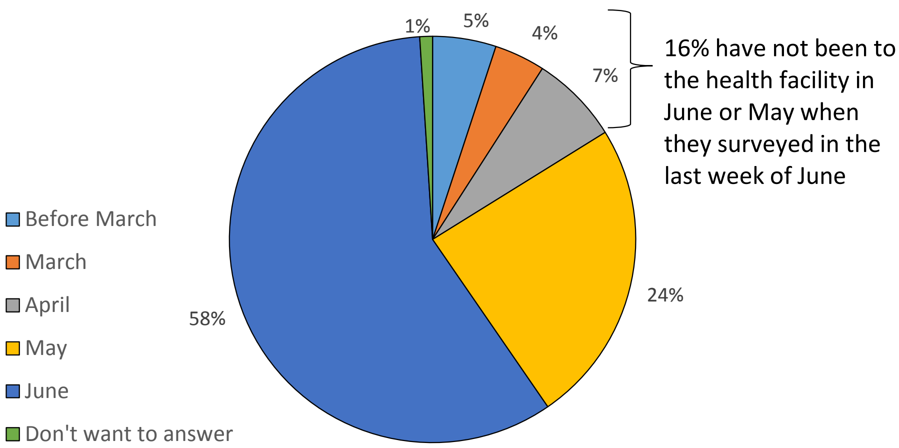
Data source: DHIS (national-level data): January 2018 to August 2020

Regression results (presented in Appendix Table B1) show there was a robustly significant decline in immunisation coverage for infants under one year of age and in the proportion of ANC 1st visits that occurred before 20 weeks in April and May 2020. Results in Table 2 show that the decline in immunisation coverage was substantial, while the decline in the proportion of ANC 1st visits before 20 weeks is much more modest. In fact, the final two columns of Table 2 shows that antenatal care was less strongly affected by the pandemic and pandemic response than the other indicators. Early access to ANC also recovered more rapidly.

Considering clinic attendance from the perspective of the mothers, Figure 8 shows that 16% of the 3 140 mothers and pregnant women respondents in the MatCH SMS survey said they had last visited a facility in April or earlier. This represents an approximately two-month gap in clinic attendance, which would be a long gap for the pregnant women in their second and third trimester, who are required to visit the clinic every six weeks. Additionally, 25% of the 300 mothers in the sample whose babies were eight to 16 weeks old at the time of the survey had not been to the clinic in two months, providing evidence of missed or delayed vaccinations at six, 10 or 14 weeks. Figure 9 shows that most of the 513 women whose last visit to a facility was in April or earlier, reported not attending healthcare services because they were afraid of the Coronavirus.

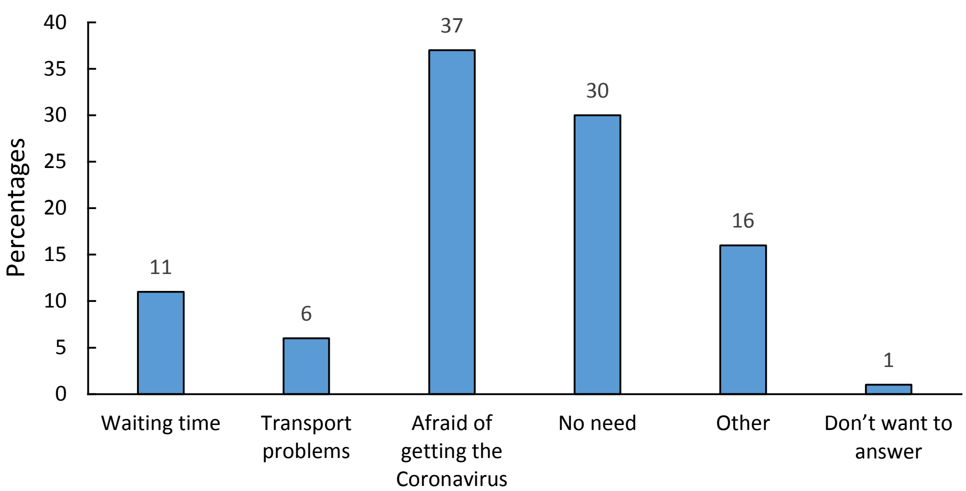
However, it should be noted that non-attendance at healthcare facilities was higher among the mothers who have given birth (in particular, those with older babies) than among pregnant women. Only 5% of pregnant women (44 of the 910 in the sample) reported not attending a health facility since April, while 14% of mothers with babies six months or younger (153 of 1 068 women) and 27% of months with babies aged six to twelve months (316 of 846 mothers) reported that they had not been to the health facility over the previous two months. Fear of contracting COVID-19 was the most frequently cited reason for not seeking care in all three groups of women.

Figure 8: Month of last healthcare visit



Source: MatCH SMS survey Wave 1 (2020)

Figure 9: Why have you not visited the health facility over the past two months?



Source: MatCH SMS survey Wave 1 (2020)

Table 3: Why not going to clinic/hospital for two months, by trimester and baby age

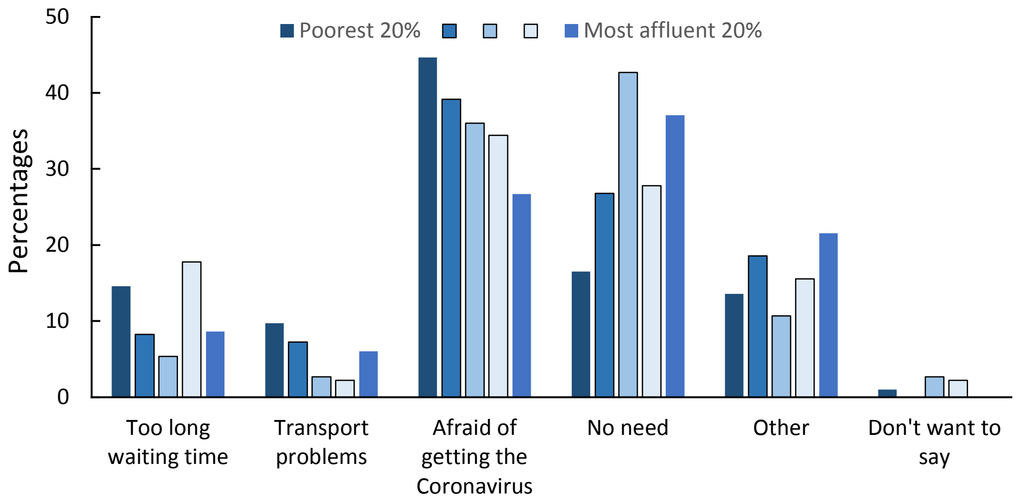
	Pregnant women (2nd or 3rd trimester)		Babies 0–6 months		Babies 6–12 months	
	No.	%	No.	%	No.	%
Waiting time	6	14	19	13	28	9
Transport problems	6	14	11	7	14	5
Afraid of getting the Coronavirus	16	36	48	32	121	39
No need	9	20	41	28	99	32
Other	7	16	25	17	49	16
Don't want to answer	0	0	4	2.7	1	0.3
TOTAL	44	100	148	100	312	100

Source: MatCH SMS survey, Wave 1 (2020)

The fears seen in the category responses were mirrored in the open-ended responses to a question asking the mothers to name one thing that they were most worried about. The respondents were able to leave the response empty or to enter any text within the 160-character limit set for an SMS. The replies included many broad worries about COVID-19, but also many specific concerns about how to keep their unborn or young children safe from the Coronavirus. One mother replied that she was worried about "going to the clinic for my baby's vaccine and afraid of contracting Coronavirus". Another explained that she had a complication in her pregnancy: "I have gotten overprotective for my baby. With this virus I'm so scared to leave my house." One mother with a newborn said that she was worried about infecting her baby: "I worry that we may put her life in danger going to the clinic and Home Affairs".

This sample of women all attended public sector healthcare facilities and is therefore not representative of South Africa in terms of income. As described earlier, we have linked information on income from Statistics SA Census data and can investigate income disparities within our sample. When we explore healthcare attendance by income group, the wealthier 60% of mothers were slightly more likely to attend in the last two months than the poorer 40% (86% vs 83%). However, of those who did not access care, 45% of the poorest 40% of respondents reported fear of contracting the virus as the reason for non-attendance, while such fears were less frequently cited (33%) among the remaining 60% of women.

Figure 10: Reasons for not visiting the health facility recently and poverty quintiles

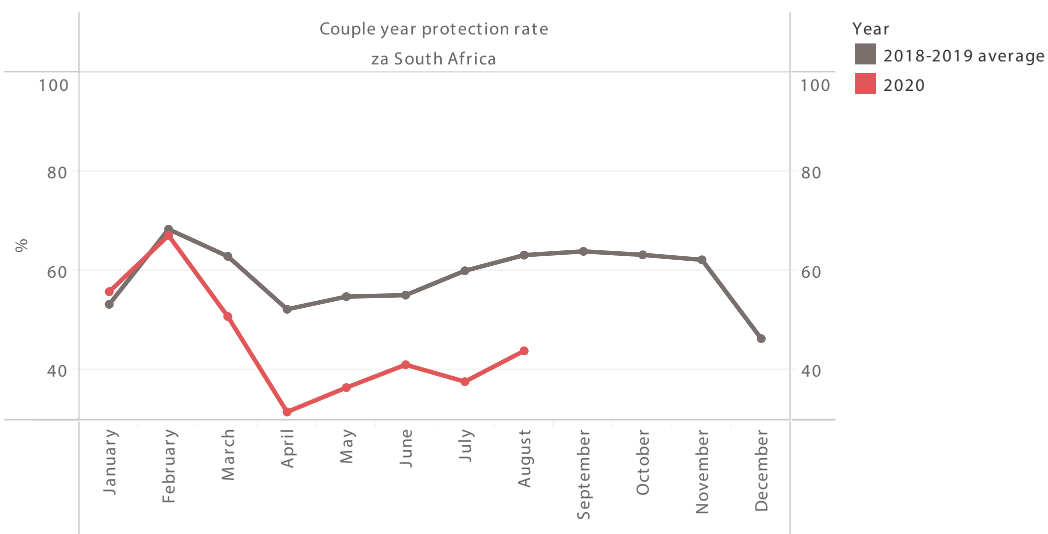


Source: MatCH SMS survey Wave 1 (2020)

Access to medicine and contraception

Data on the couple-year protection rate (CYPR) were extracted from the DHIS. CYPR is an indicator of aggregate delivery of contraceptives through the district health system.[12] Within the CYPR, male condoms account for 39% of couple-years of protection. Figure 11 shows that the seasonal decline in the CYPR (March to June) is more pronounced in 2020. The DHIS stock-out measure changed in April 2020 which unfortunately makes it difficult to use routine data assess the extent to which stock-outs contributed to this fall. The CYPR remains below the 2018–2019 level from April to August 2020.

Figure 11: Utilisation of contraception (CYPR), by month 2018 to 2020



Data source: DHIS January 2018 to August 2020

Regression analysis (shown in Appendix Table B1) shows that, once seasonal patterns are controlled for, there was a robust, significant decline in the CYPR in April and May 2020. The results in Table 2, and the graphical depiction of the data, both suggest that the decline in the CYPR was large. Only HIV tests declined more strongly over hard lockdown than this indicator.

12 See the definition of CYPR in the appendices. CYPR covers multiple methods of contraception distributed to the population. To be interpreted as a measure of utilisation requires the assumption that all methods distributed for contraception are used for that purpose. For example, it assumes that all condoms distributed are used for contraception.

This indicator cannot be directly compared to the data in NIDS-CRAM which measures self-reported access to medication, condoms and contraception (combined). However, it is validating that both sources reflect a decline in availability of this form of preventative health care during lockdown Levels 4 and 5.

Eighteen per cent of NIDS-CRAM respondents who do not have medical insurance reported having a chronic condition such as HIV, TB, a lung condition, a heart condition or diabetes. As shown in Table 4, a quarter (25%) of uninsured respondents in need reported not having access to the medication, condoms, or contraceptives that they required. The table summarises access for the total sample and for those with chronic conditions. It also provides the differences by medical insurance, income quintile and gender. A high fraction of uninsured participants with a chronic condition (42%) reported being unable to access medication, condoms or contraception.

Table 4: Access to vital medicine, condoms or contraception

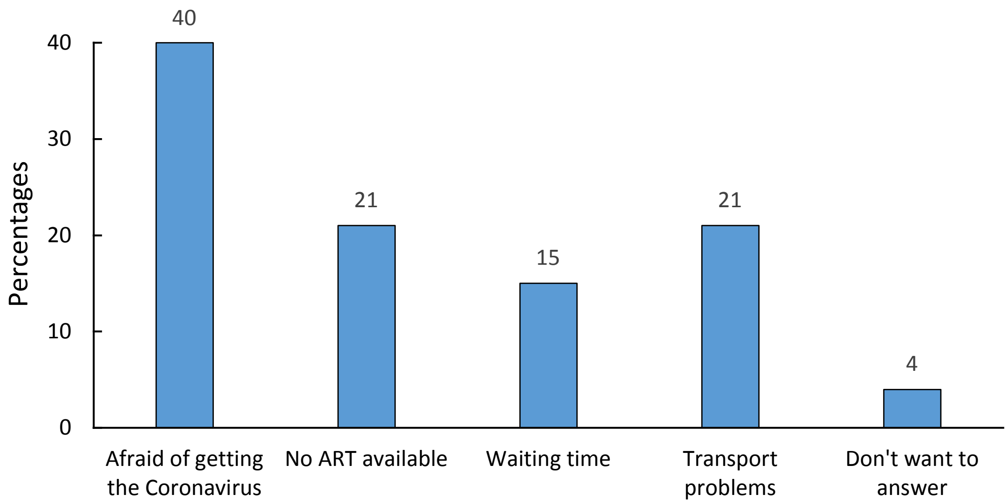
		Total sample		Could not access		Chronic condition		Could not access	
		N	%	N	%	N	%	N	%
Total		7 074		1 919	23%	1524		705	39%
Medical aid	**Yes**	**1 111**	**22%**	**250**	**17%**	**255**	**24%**	**83**	**24%**
	No	5 942	78%	1 664	25%	1 269	77%	622	42%
	Missing	21	0.3%	5	5%	0	0	0	0
Income quintile	**0-20%**	**912**	**13%**	**268**	**26%**	**190**	**12%**	**88**	**46%**
	20-40%	1 047	13%	306	24%	269	16%	122	41%
	40-60%	967	12%	268	24%	257	14%	137	49%
	60-80%	884	12%	238	24%	196	14%	89	35%
	80-100%	595	12%	137	17%	107	11%	37	26%
	Missing	2 669	38%	702	23%	505	32%	232	36%
Education	**Primary**	**982**	**12%**	**328**	**32%**	**324**	**19%**	**171**	**53%**
	Secondary	3 877	54%	1 032	23%	784	50%	352	36%
	Tertiary	1 817	30%	436	19%	302	24%	125	29%
	Missing	398	4%	123	28%	114	7%	57	55%
Gender	**Male**	**2 754**	**47%**	**665**	**22%**	**398**	**34%**	**189**	**42%**
	Female	4 314	53%	1 253	24%	1 125	66%	515	36%
	Missing	6	0.1%	1	8%	1	0.1%	1	100%

Source: NIDS-CRAM Wave 1 (2020)
Note: The count of available observations that appear in the N column for total 'Sample' and 'Chronic condition' do not take account of 34 missing values for the variable of interest or seven observations without assigned weights in this early version of the data. The N column for 'Could not *access' incorporates both these omissions. Percentages are all weighted.*

Access to antiretroviral therapy

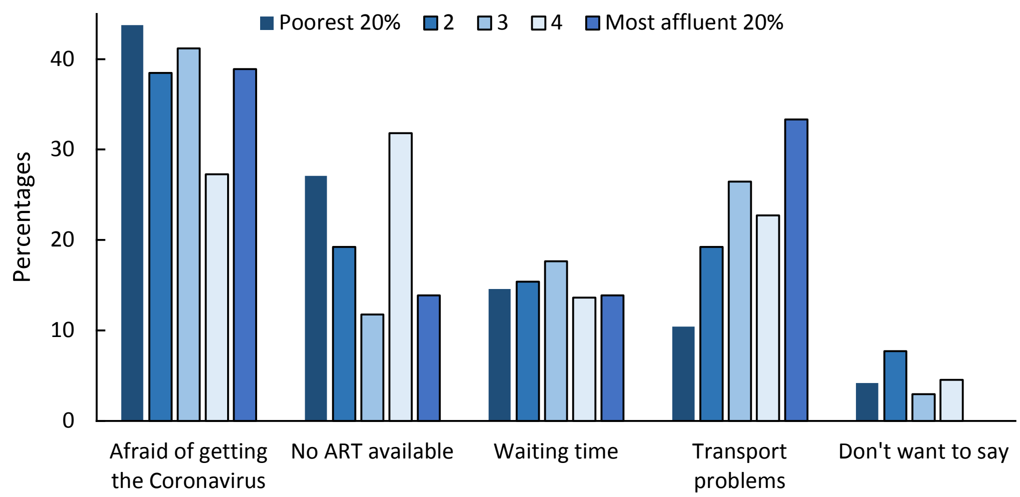
Routine data on ART utilisation were not analysed in the DHIS, as some of these data are available only quarterly. Data on access to ART during lockdown are, however, available for a subsample of 1 610 respondents in the MatCH survey. Of the 1 610 women who require ART, 11% (175) said that they run out. An unacceptably large fraction (21% of 175) said that ART was not available at the facility, as shown in Figure 12. The most commonly reported reason for not attending the facility to collect ART was fear of contracting COVID-19 (40%).

Figure 12: Reasons for running out of ART



Source: MatCH SMS survey Wave 1 (2020) (n=175 women who reported running out of ART)

Figure 13: Reasons for running out of ART medication, by wealth quintile



Source: MatCH SMS survey Wave 1 (2020) (n=175 women who reported running out of ART)

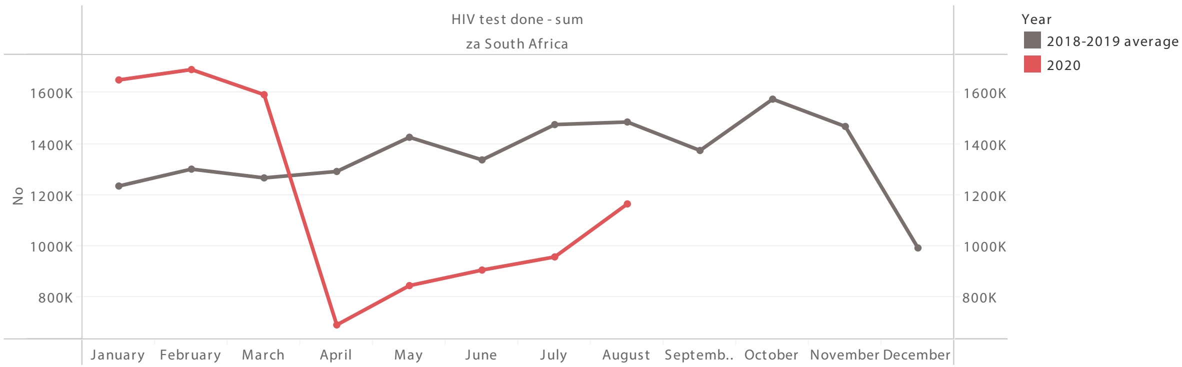
No evidence could be found to suggest that COVID-19 fears are more likely to be experienced by mothers who live in districts with higher COVID-19 prevalence.[13] One would expect that in districts that have seen a negligible number of cases, one should see a very low number of cases of missed healthcare visits attributed to COVID-19 fears. However, this is not what is observed: in districts with fewer than 20 cases of COVID-19 per 100 000, the likelihood of COVID-19 fears restricting health-seeking behaviour is not significantly lower than for other districts. This shows that there is little evidence of fears being rooted in clinical risks.

13 The prevalence of COVID-19 fear was examined as a proportion of the total sample and as a proportion of respondents who did not seek health care despite having such stated needs, relative to district-level COVID-19 prevalence. As a caveat, district-level prevalence may not always be an accurate reflection of COVID-19 risks, because districts are quite large.

HIV testing

The total number of HIV tests performed dropped dramatically in April 2020 and exhibited a slow recovery over the ensuing four months (Figure 14). Regression results confirm the significant decline in HIV testing in April and May 2020 (Appendix Table B1) and suggest that HIV testing rates remained significantly below the projected utilisation rates in June and July 2020. HIV testing was not included in the questions in the NIDS-CRAM or MatCH SMS survey. Regression analysis (shown in Table 2) confirms that the decline in number of HIV tests over the lockdown period was worryingly large.

Figure 14: Total number of HIV tests done, by month 2018 to 2020

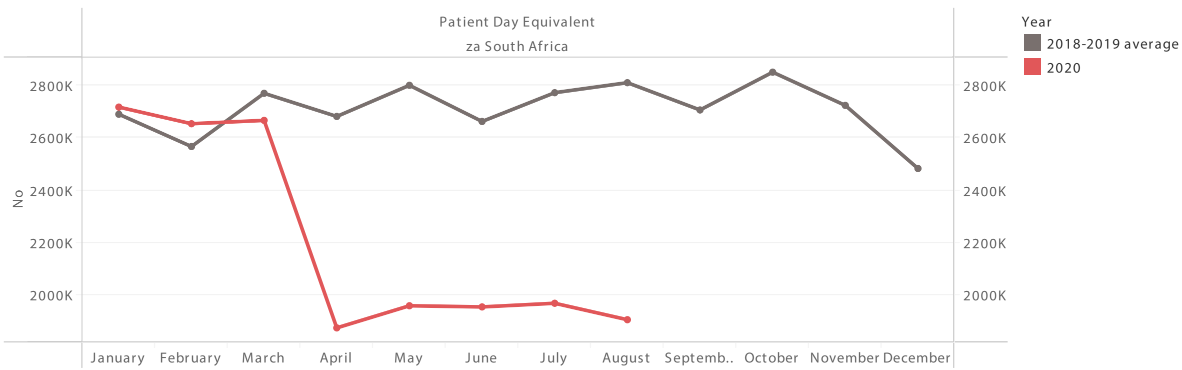


Source: DHIS January 2018 to August 2020

Inpatient utilisation

Figure 15 demonstrates that patient day equivalent (PDE) (a composite measure of various types of hospital utilisation) dropped substantially in April 2020, recovered somewhat in May, but remained suppressed until August 2020. Regression results (shown in Appendix Table B1) show a robustly significant decrease in inpatient bed utilisation rates and PDE, providing further evidence that hospitals were being vacated in this period. Table 2 suggests that the decline in inpatient bed utilisation in April and May 2020 was substantial.

Figure 15: Patient day equivalent, by month 2018 to 2020



Data source: DHIS January 2018 to August 2020

What factors mediated the decline in health service utilisation?

We examine how the lockdown affected utilisation of health services in different areas of the country. We create a summary measure capturing the extent of the service utilisation impact with a ratio of actual average indicator value in April and May 2020 to the projected value for these months, based on a 27-month model running from January 2018 until March 2020 (see Table 2). We find that across districts, there was a large drop in the utilisation of health services during the hard lockdown. However, patterns of recovery and the extent of the decline appear to differ across indicators and districts. More pronounced declines were observed in more affluent districts. However, the effect remains significant even in the poorest and most remote districts. COVID-19 prevalence had no significant correlation with the health services utilisation impact of the lockdown.

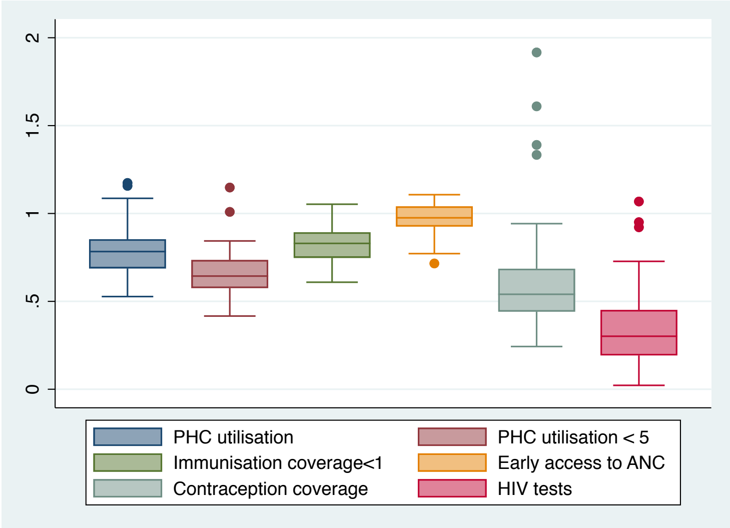
In Appendix Table 6 we examine how this inter-district variation correlates with factors such as skilled health staff per capita, public sector expenditure per capita, hospital beds per capita, COVID-19 prevalence, and data quality metrics. The only significant relationship is a positive association between district hospital beds per capita and PHC utilisation by children under five, implying a protective effect of hospital beds against a lockdown-related decrease in PHC utilisation by children under five. None of the other expenditure and staffing ratios had a significant relationship; nor do we see poverty or population shares making a difference. Data quality metrics were not significant when correlated with lockdown-related utilisation impact.

Variation across districts

Figure 16 depicts district-level variation in the impact of the hard lockdown (April and May) as box-and-whiskers plots. It shows each of the six different health services: PHC utilisation (total), PHC utilisation (for under 5s), immunisation coverage for infants under 1 year, contraception coverage (CYPR), early access to antenatal care (1st visit before 20 weeks), and HIV testing. Because the indicator definitions are not strictly comparable, we avoid directly comparing the magnitudes and deviations of these indicators, except for PHC utilisation for all patients and for children under five (which are directly comparable). The figure shows that the under 5 utilisation rate was more affected than the PHC utilisation rate for all patients. The reference point in this analysis is 1, representing the predicted level of service utilisation for each indicator based on a model of the pre-pandemic period. Note that for these graphs, the bars are not significance levels but show the upper adjacent value, which is the largest observation that is within 1.5 times of the interquartile range (distance between 25th percentile and 75th percentile for this variable) above the upper hinge (75th percentile).

Appendix Table 7 examines correlations in cross-district variation in the impact of lockdown on service utilisation. We find that the effect on service utilisation was significantly more pronounced for the Western Cape and for Gauteng for PHC utilisation and PHC utilisation under 5. For the Western Cape, it was also significantly lower for early access to antenatal care, and for Gauteng, it was also significantly lower for HIV tests. This does not mean that the drop was not significant for the other provinces, but that the drop was significantly greater for Gauteng than for others.

Figure 16: Box-and-whiskers plots of lockdown-related decreases in six key PHC utilisation indicators across the districts of South Africa, April & May 2020

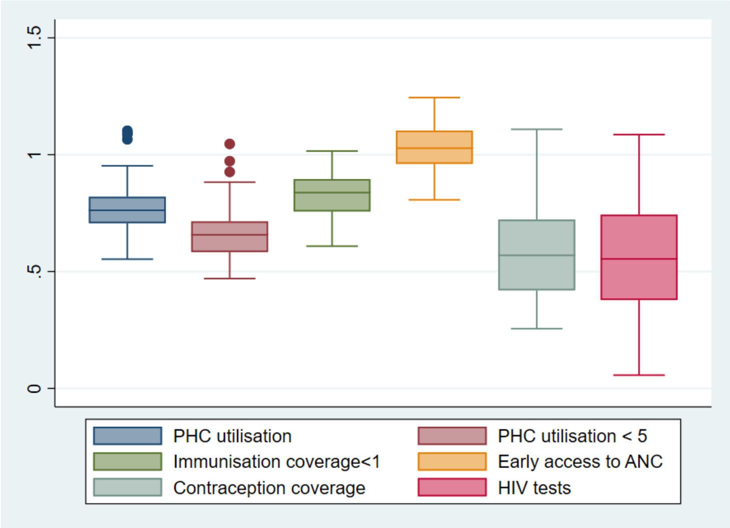


Source: DHIS 2018–2020

Recovery of health utilisation by July and August

We also consider the sustained impact, focusing on health service utilisation levels in July and August, again compared to predicted levels based on pre-pandemic patterns. Figure 17 shows that apart from early access to antenatal care, health services are still, on average, below expected levels, with 1 being the reference point here, representing the expected or predicted level before the pandemic hit. For total PHC utilisation and under 5 PHC utilisation, immunisation coverage, contraception coverage and HIV tests, we see that the 75th percentile upper hinge of the box-and-whiskers plot lies below 1 which suggests that five months after the pandemic broke out, service levels are still below their pre-pandemic levels for three-quarters of the districts. Overall, we see a slow recovery.

Figure 17: Box-and-whiskers plots of sustained decreases in six key PHC utilisation indicators across the districts of South Africa, July and August 2020



Source: DHIS 2018–2020

Appendix Figure 1 and 2 allow a more granular view, showing the 2020 time trends per province and district for these six service areas, and also patient day equivalent indicator for hospitalisations. The graphs show the percentage difference in value for each indicator relative to March 2020 for each indicator-geographic area combination.

Discussion

Countries must achieve the optimal balance between responding to the COVID-19 pandemic and maintaining essential health services. This is critical for maintaining preventative and curative services, especially for the most vulnerable populations such as children, pregnant women, older persons, people living with chronic conditions, minorities, and people living with disabilities (Roberton, et al., 2020; Jones, et al., 2016).

Most fundamentally, the comparison of these three data sources on healthcare utilisation allows one to show that health services were impacted, and this impact matters. Throughout this paper we have highlighted that not all services were impacted in the same way. Services that were life-saving or essential and could not easily be postponed were less heavily impacted, and some of this was by design because of the suspension of elective services to prioritise COVID-19 patients. Torlutter (2020:143) reported that in Gauteng hospitals saw increases in burns in children, domestic violence, strokes and heart failure from decompensated chronic diseases, patients with stage 3 or 4 cancer presenting with complications from interruption of their cancer treatments in hospitals.

It is important to highlight that this does not imply that the observed decline in health service utilisation largely represents less-essential services, and thus matters less. Surveys widen the view: they complement the analysis of the routine data because they enable inclusion of services that are not well-tracked by routine data, such as chronic care, or which are difficult to track due to the complication of accounting for higher usage of the Central Chronic Medicine Dispensing and Distribution (CCMDD) pick-up points and home deliveries of medication (such as ART). Additionally, the survey data allow us to observe unmet health needs because survey questions typically use a health needs filter to arrive at the relevant subsample, but more importantly enable one to ask respondents why they did not seek care for their health needs. Although the findings are often based on comparatively small samples, this additional information source helps to strengthen the conclusion that the observed decreases in healthcare utilisation led to unmet health needs.

Given the wide-ranging impact of the pandemic and the lockdown on the lives of South Africans, it is useful to analyse routine data utilisation alongside user surveys because this allows one to observe both changes in health service utilisation (from routine data) and changes in unmet health needs (from surveys), and consequently enables a better understanding of the relationship between these. One may for instance be concerned that the drop in utilisation may overstate the impact on unmet health needs, because utilisation fluctuations during the lockdown will be expected to disproportionally affect less urgent types of care and could be partly explained by changes in health needs due to better hygiene and less frequent social interaction.

When interpreting both the survey and DHIS data, one should also consider the possibility that the declines in healthcare utilisation might have been partly due to reduced healthcare needs due to reduced incidence of communicable diseases (such as diarrhoea, TB and influenza) during lockdown. Given the incubation periods for communicable diseases, one would expect the reduction in healthcare utilisation to occur with a lag. Instead, the data show that the largest declines in utilisation occurred in April. Reduced incidence and prevalence of communicable diseases may partially explain continuing low levels of utilisation through to August 2020. However, the large declines observed in HIV testing and in immunisation coverage cannot be explained (even partially) by these factors.

Our analysis shows large declines in service utilisation across a range of health services. In July and August, the country was largely at Alert Level 3 with most individual freedoms restored, and since 16 August, South Africa has moved to Alert Level 2[14] and then Alert Level 1. However, analysis comparing service utilisation levels for July and August with pre-pandemic predictions provides little evidence of recovery in healthcare utilisation. There is, however, some variation across services and districts. Early access to ANC recovered quite quickly after April 2020. Immunisation coverage for infants under one year of age declined much more rapidly in April 2020 but began to recover in

14 Schools were closed for most of August, but this is not a compelling reason for the sustained lower levels of utilisation observed in the routine data

May. Yet, five months after the pandemic hit, service levels for PHC utilisation (for children under five years), immunisation coverage and contraception coverage are still below the pre-pandemic levels in three-quarters of health districts. This suggests that it would be important for the National Department of Health and provinces to accelerate implementation of recovery plans and closely monitor the impact of their recovery plans, especially given that it is now becoming apparent that there will be further surges and COVID-19 will remain a significant threat for most of 2021.

In the following sections, we discuss and contextualise our findings with respect to each of the clinical areas, comparing the analysis from the three data sources.

Acute and chronic care

We find evidence of unmet health needs in both the NIDS-CRAM and the MatCH surveys. This is corroborated by evidence of reduced healthcare utilisation in April and May 2020 from routine DHIS data. For most of the indicators analysed, there is evidence that health utilisation remained below expected levels in July and August 2020.

Our analysis shows a substantial decline in the mean number of annual visits to PHC facilities during April and May 2020 for the population overall. These declines in PHC utilisation were sustained in June and July as lockdown restrictions were eased. The PHC utilisation rate is a reliable indicator of overall utilisation, as it is based on a simple headcount of visits per healthcare facility per day, which is not onerous for clinics to complete.

Importantly the decline in the mean PHC utilisation was from levels which were already low (Massyn et al., 2020) and were far below the target rate of 3.2 visits per person per year used in PHC resourcing models (Davén, et al., 2018). Some reduction in PHC utilisation may be due to the expansion of the CCMDD programme, but at this stage, given data availability, it is not possible to determine the extent of CCMDD expansion since March 2020. These marked declines in utilisation suggested by this analysis are likely to result in substantial unmet healthcare needs, which could be associated with higher demand for health care in the future.

This aligns with the findings from the NIDS-CRAM survey, showing substantial unintended distortions to acute care. Vollmer et al (2020) warned that during pandemics there is a risk that unmet acute health needs may only be picked up once it is too late, in ex-post excess mortality analyses.

Data from NIDS-CRAM show that access to chronic care consultations were less severely affected in Levels 4 and 5 of lockdown. We were unable to confirm this trend in the DHIS data, as indicators are not directly comparable. We believe that there are reasons to be cautious when interpreting the NIDS-CRAM results for chronic care. First, one should be wary of the subjective interpretation of one's own need for health care, and how this can shape responses. In the context of a hard lockdown, the concern is that respondents may implicitly raise the bar for whether they "needed to see a healthcare worker" given that the perceived risk of a health visit was higher and there were restrictions on movement. Secondly, because the question in NIDS-CRAM asked respondents whether they needed to see a healthcare worker for their chronic condition, they are unlikely to interpret this question to include the collection of medicine, which may often be from the pharmacist and would rarely be regarded as a consultation. This interpretation is compelling because while the survey shows very low shares of respondents with a chronic condition reporting that they lacked access to chronic care (based on this question), we find evidence of problems with access to chronic medicine – based on the question on ART access in MatCH and the question on access to medicine and contraception for chronic patients in NIDS-CRAM.

The patchwork of data we have available makes it difficult to reach strong conclusions, but indications would be that chronic care may have been less severely affected than other forms of care such as acute care, as well as screening and preventative care. Also, there are signs that treatment for chronic care was disrupted and further investigation is required. Unfortunately, the routine data is not very useful in this regard. There are several indicators in the DHIS on delivery of health care to patients with specific chronic conditions (for example, diabetes). However, most of these were introduced to the National Indicator Data Set quite recently and the time series was judged to be too short for robust analysis. Thus, we cannot corroborate this upper-bound estimate of interruptions to treatment of chronic conditions from NIDS-CRAM.

Healthcare visits by pregnant women and mothers with infants

Evidence from the DHIS analysis suggests that PHC utilisation for children under five years showed a greater decline than for the population as a whole. PHC utilisation for children under five years is unlikely to be impacted by the expansion of the CCMDD, as chronic conditions form a very small proportion of healthcare needs among young children. This stands in contrast with findings from the MatCH survey where there were very few cases of mothers reporting that they did not take their children to the facility when they need care. The discrepancy may be due to the wider age range covered in the DHIS routine data and associated differences in risk of postponing care and immunisations [under 5s vs. mothers with children under 12 months] or social desirability bias which may lead to an underreporting of unmet health care needs of infants by their mothers.

The drop in PHC utilisation for children under five aligns with the decrease in immunisation coverage for children under 1 year and the latter would be responsible for part of the observed drop in PHC utilisation. The decrease in immunisations and the slow recovery in immunisations are likely to affect the future burden of disease. Modelling and past experience suggest that the impact of delayed or skipped immunisations due to COVID-19 may outweigh the direct cost of COVID-19.

Results from the MatCH SMS survey show that 37% of pregnant women and mothers with infants who last visited a clinic or a hospital in April or earlier, reported not visiting a health facility for fear of contracting COVID-19. The MatCH survey results suggest that among pregnant women and younger mothers, fear of COVID-19 deterred healthcare-seeking more strongly among poorer women.

It is encouraging that the DHIS data suggest a lower impact on the proportion of ANC 1st visits that occurred before 20 weeks and that of all the DHIS indicators analysed here, ANC 1st visits rates show the strongest recovery. It may suggest that there is a belief that while health visits for children under 5 can safely be delayed early access to antenatal care is vital for a health and safe pregnancy.

Maternal, newborn, child and adolescent health services are critical for women, children and adolescents, and disruptions may lead to sexually transmitted diseases, and increased health risks for mothers and their newborn babies, and children and adolescents. For instance, the breakdown of such services has been estimated to lead to major excess deaths of children under five years of age and increases in maternal and neonatal mortality as well as stillbirth (WHO, 2020a; Watson, 2020). A sufficient number of timely antenatal care visits of adequate quality is required to minimise both the potential negative health outcomes for mothers, (at the most severe mortality), as well as optimise positive health outcomes for their babies – including birth weight and the probability of poor birth outcomes (Gajate-Garrido, 2013). Maternal and child health still accounts for a significant burden of disease in South Africa. South Africa has made considerable progress in reducing maternal and neonatal mortality over the last decade (Damian, et al., 2019) and it is paramount that these gains are not reversed. Failing to meet the healthcare needs of young children can have long-lasting effects.

Access to contraception

Data in the DHIS show that contraception delivery (measured by the CYPR) declined significantly and substantially in April and May 2020. In April and May 2020, there was more variation in the CYPR (by district) than in other coverage indicators analysed. This suggests that the extent of the disruption to contraception delivery differed across districts. It is critical that this area of cost-effective and essential preventative care be prioritised during subsequent waves of COVID-19. The knock-on effects of disruptions in delivery of this service could have long-term ramifications for HIV, other sexually transmitted diseases, and unwanted pregnancies. Access to condoms is currently largely dependent on access to PHC facilities. Expanding condom distribution to non-medical sites may help to expand and diversify access to condoms.

Access to medicine

The DHIS tracks stock outs but it does not track consistent collection of chronic medication. Delivery of care to chronic patients can serve as a proxy, but unfortunately these indicators were introduced too recently to be eligible for inclusion in this study. Due to lack of space in a short CATI questionnaire, the NIDS-CRAM survey asked a combination question about access to chronic medication, contraception and condoms. However, when one analyses this variable for the subset of patients who said that they have chronic conditions, it can be interpreted as an upper-bound indication of problems with access to chronic medication. We find that 42% of uninsured respondents with self-reported chronic conditions said that they experienced problems with access to treatment, contraception or condoms.

Our best evidence is on access to ARTs for pregnant women and mothers with infants. The surveys suggest that access to ART was impacted in May and June. While supply-side problems featured in the form of medication not being available, it is not clear whether this was due to drug stock-outs or to other problems at the healthcare facility.

An interruption in ART risks the health of the mother and increases the risk of transmission to the baby. For the same reason, we would expect ART adherence to be considerably higher among this group than among others. Therefore, we consider this to be an underestimation or a lower bound estimate of ART interruptions among the full population. Unfortunately, we were unable to analyse ART retention in care in the DHIS data due to technical reasons, at this stage, in order to corroborate these findings.

HIV testing

Regression analysis of DHIS data shows that HIV testing volumes fell sharply in April and May 2020 and remained below predicted pre-pandemic levels in June and July. This represents a substantial missed opportunity in the fight against HIV. South Africa has committed to the UNAIDS 90-90-90 strategy (90% of those living with HIV are aware of their HIV status; 90% of those living with HIV are on ART; and 90% of those on ART are virally suppressed). Declines in testing on this scale may threaten the achievement of the first of these goals (which South Africa first met in 2018). Testing is a critical pathway into HIV treatment. Currently, 71% of people living with HIV are on ART in South Africa (UNAIDS data, 2020). Further expansion may be delayed by the disruptions caused by COVID-19. It is essential that HIV testing continues to be encouraged during the COVID-19 pandemic and this may make the case for the expansion of HIV self-screening and home-based testing.

Inpatient utilisation

The DHIS provides evidence of reduced inpatient utilisation, both in terms of the inpatient bed utilisation rate (which covers admissions only) and the patient day equivalent (which covers day cases and admissions). These trends should be interpreted somewhat differently to the other indicators. Largely, the occupancy of hospital beds was intentionally reduced in anticipation of the surge in COVID-19 admissions which had been experienced in other countries. In the short and medium term, there are likely to be substantial waiting periods for elective surgery, which was postponed to free up hospital beds from April to August 2020. The media has reported that special efforts have been made by tertiary hospitals to address the pent-up demand for surgeries and elective procedures (Jeranji, 2020).

Fears of contracting COVID-19

Fear is no doubt an important and unavoidable component of raising awareness on the pandemic. But in South Africa we find that fear interfered with health seeking behaviour and affected health seeking behaviour in places and at times when the risk of contracting COVID-19 was minimal. Fear of contracting the COVID-19 virus was the most commonly cited reason for respondents not seeking care for acute illnesses and maternal and child health services. Similarly, fear of COVID-19 was the most frequently cited reason for not collecting ART medicine.

Our analysis shows that these fears do not have a significant relationship with the prevalence of COVID-19. This finding demonstrates the perils of a lack of transparency, ineffective risk communication, and an approach that does not differentiate based on the risk of the district. Similarly, we see no relationship between district-level health service utilisation declines shown in routine data and COVID-19 prevalence. Health services suffered irrespective of the magnitude of the COVID-19 risk. The analysis suggests that health services were disrupted by COVID-19 fears in districts where the risk was in fact minimal.

The survey findings are a reminder of the importance of demand-side factors. They are often neglected. For instance, in a recent paper on the impact of the pandemic on maternal and child health in low- and middle-income countries (LMICs), demand-side problems and concerns featured in only one scenario, and then featured only as a relatively small driver of impacts (Roberton, et al., 2020). However, these findings warn that demand-side issues can be as if not more important as potential supply-side disruptions. Fear of contracting the virus is a possible explanation for the continuing low levels of utilisation of health care from June to August 2020, when movement restrictions began to be lifted (limiting supply-side constraints), but COVID-19 prevalence and mortality increased during this period, possibly raising fear-related demand-side constraints. Torlutter (2020:142) argues that fear has had vast unintended consequences: “The way we had handled our response in clinics contributed to driving fear into communities. Places of healing had now become highly stigmatised places of potential infection. Clinic staff were shunned if they got SARS-CoV-2, and patients were turning down life-saving treatment in fear of contracting SARS-CoV-2 from clinic settings.”

Similarly, Loewenson et al (2020:1) highlighted the perils of centralised and authoritarian pandemic responses, emphasising that “effective public health in a protracted pandemic like COVID-19 requires cooperation, communication, participatory decision-making and action that safeguards the Siracusa principles, respect for people’s dignity and local-level realities and capacities”.

Variation across provinces and districts

The analysis of DHIS data shows that declines in healthcare utilisation were greatest in Gauteng and the Western Cape. The sharper declines in health services observed in these provinces may be related to proactive measures to decongest clinics and limit services, including the decanting of the distribution of chronic medicine using home deliveries and the CCMDD pick-up points. Louw, et al. (2020) and Brey, et al. (2020) have documented the impact of home deliveries of medicine. The DHIS started tracking CCMDD collections in April 2020 and the data show a strong increase from April to May and June, but the indicators are not yet reliable enough on a granular level to allow analysis of the share of the observed drop in visits attributable to CCMDD decanting.

In the case of Gauteng, the drop in utilisation may be related to the Gauteng Department of Health’s decision on 7 April 2020 to limit PHC services to emergency cases and pregnant women only. This decision was motivated by a concern for the protection of staff and patients from COVID-19, but its enduring negative impact on health services is likely to dwarf such benefits (Torlutter, 2020; Gauteng Department of Health, 2020). While there was initially some confusion among PHC facility staff about what constituted ‘emergency services’, Torlutter (2020) reports anecdotal evidence suggesting that in practice, this restriction affected at least immunisations, family planning, blood tests and sexually transmitted diseases.

Limitations of data

The timeous availability of routine health services data has been demonstrated to be useful both for research and for management of health services, enabling assessment of the degree of disruption of health services as well as informing responses (Leon, et al., 2020). Much remains to be improved, however, in terms of data quality, inclusion of both the private and public sectors, and responsiveness of the health system.

Since the DHIS is based on aggregated counts of selected health service activities, this source of routine data is not able to track outcomes or related services in particular patients, such as age, sex, co-morbidities, or socio-economic status. Over the 20-year period of DHIS implementation, the development of standard operating procedures and various automated and manual processes for data validation and quality control have improved the reliability and utility of the data. However, it is apparent that multiple challenges to optimal data quality remain, including systematic challenges and variable localised data errors. The elements collected by the system are usually revised every two years, necessitating production of new data collection and capture tools; the system is thus relatively unresponsive to adaptation for collecting new information that is relevant to health systems management. Additionally, although the system allows for the addition of new organizational units, it was apparent that many of the temporary facilities introduced to deal with the COVID-19 pandemic are not reflected in the data. It should be noted that this study made use of monthly data as soon as they became available in the national DHIS instance, and that these data would not yet have been subjected to the annual data verification process that occurs following the end of a financial year. These should therefore be regarded as interim findings.

More broadly, the study raises concerns about the inadequacy of monitoring of non-communicable disease service utilisation through routine health facility data. Routine data for NCDs have not been standardised or prioritised to the same extent as for maternal, child and communicable diseases, yet NCDs are the largest contributor to years of life lost. Improving the validity and utility of NCD indicators is key to understanding the impact of disruptions of chronic care preventative and treatment services.

It is important to acknowledge that while large increases in unmet health needs were found through our household survey, these large increases arise from a relatively low base, so the reduction in healthcare utilisation would represent a small overall share of utilisation. Our findings here are lower than what would have been expected based on very large reported drops in TB tests and ART visits observed in some routine data, such as the testing report by the NICD (2020).

There could be several plausible explanations for this apparent discrepancy. For this investigation, we have selected services and subsamples where care matters most, but demand factors such as Coronavirus fears would be expected to play a lesser role, where care matters most.

Additionally, these are self-reported data, and given social desirability bias, respondents may tend to under-report interruptions in their treatment and their access to care, especially in the context of being an expectant mother or having a young baby, where there are strong social norms about the duty of care. Furthermore, SMS and CATI surveys have lower response rates. While we have been in the fortunate position of having access to large and fairly representative master samples, and we are able to stratify our samples on variables that we expect to be correlated with our key outcomes, some selection based on unobserved heterogeneity will remain in the self-selection of participants into the survey sample, and this could bias our findings. Given the rates of non-response, this concern should be borne in mind when making sense of the findings reported here. It is for these reasons that corroboration with DHIS data, which measures healthcare utilisation nationally, is important.

While each the data sources has discrete concerns and weaknesses, these are the best data sources available to answer this important and timely research question; furthermore, using them together means that one is not as exposed to each dataset's specific 'blindspot' in terms of how the South African experience with public healthcare utilisation during the COVID-19 pandemic is documented.

Policy recommendations and conclusions

Over the short-term, the focus should be on **restoring health services utilisation** to pre-pandemic levels.

- **Less command, more co-ordination:** The significant risks presented by the COVID-19 pandemic to the South African population, particularly in the context of a quadruple burden of disease, required a swift and decisive approach to the containment of transmissions. The emergency response to COVID-19 has concentrated capacity with National and Provincial Command Councils but in many provinces and districts, this occurred at the expense of existing multi-sectoral co-ordination structures. Particularly at the sub-district level, such structures can play an important role in ensuring continuity of care as well as supporting the development of localised communication campaigns to encourage healthcare utilisation.

- **Lower the risks associated with preventative care and contraception:** We find that screening and preventative care was affected more than chronic care. Such care tends to have lower perceived individual benefit, while having very high social benefit. Seen from an individual decision maker health-seeking perspective, one could interpret the evidence presented here as showing that COVID-19 has further raised the cost of care seeking and it would then make sense that services with low direct immediate individual benefit would be affected most. The health system can respond by lowering the risk related to such services, concentrating on costs such as waiting time or needing to come to the facility, which are associated with enhanced COVID-19 exposure and risk. Specific strategies can include **self-testing** and **diversifying condom distribution channels** to reduce reliance on PHC facilities.
- **Understanding the cost of using fear to motivate behaviour change:** The pandemic has struck fear and panic in the hearts of many decision-makers due to its devastating impact, but also due to the large degree of uncertainty regarding the Coronavirus. While the unmet health care needs reported here may be lower than feared, an overwhelming share of those who did not seek care attributed it to the risk of contracting COVID-19. This may illustrate the unintended consequences of fear-mongering by the media, and also some public messaging. It is admittedly a difficult balance to navigate because complacency and ignorance would arguably be worse and likely to have graver consequences. During the pandemic, resource allocation decisions were informed by a risk assessment that, based on current evidence, was not informed by adjustments to the trajectory of the pandemic. A colour-coded risk-based strategy would help introduce more nuance to public health communications and teach communities to anchor their risk perceptions and their behaviour in their district's current COVID-19 cases per 100 000. It is also important to counter such fears through empowering and hopeful communication, focusing on how the virus can be avoided. Churches, sport clubs and stokvels can be important local sites for partners and champions to mobilise such messaging.
- **District-level PHC drives to boost key services:** The declines in utilisation in April and May across all indicators, along with the change in funding flows, is likely to require a specific focus on strengthening PHC responsiveness, particularly a co-ordinated mass testing strategy to mitigate the significant drop in HIV testing, immunisation and contraception. We are most concerned about the severe impact on services that have a low perceived individual benefit, but a high social benefit. It is important to highlight that these services may often not be identified via user surveys because they will not consistently and necessarily be categorised as unmet health needs by respondents. Community Health Workers effectively deployed can support this along with screening for diabetes and encouraging caregivers to bring children to facilities for immunisations.
- **Monitoring district-level DHIS data:** Related to the recommendation for more devolution to district level, a first useful step could be leveraging the use of district health information systems to identify districts and health services that should be prioritised for support. Our analysis shows that the system has not yet recovered. Continued monitoring, paired with support and well-designed interventions, will be required to restore essential health utilisation to pre-pandemic levels.
- **Helpline for at-risk patients who run out of medication:** Chronic patients, and in particular people with diabetes and hypertension, are known to have a much higher case fatality rate than others. It could be useful to consider special measures for this at-risk group of patients, including a helpline for access when they run out of medication. In Cape Town, the Western Cape Department of Health used Uber taxis to deliver long-run supplies of medicines to patients via Community Health Workers prior to the start of the lockdown, and similar measures could be used for providing continued supplies of medicine to patients with diabetes and hypertension.
- **Availability of medicines***.* Our analysis shows that access to medicine was adversely affected by the pandemic. Efforts to facilitate access to medicine despite the lockdown and amid fears of contracting the virus opened up new spaces and channels. We can now consider alternative and

less burdensome ways of distributing medicine, including dispensing in large quantities, home deliveries, and the bolstering the expansion of the CCMDD programme.

Over the medium term, where there is sufficient early or existing evidence, **systems should be reformed and resources should be reallocated to ensure that the health system is less fragmented and more responsive and robust.**

- **Balancing investments in public hospitals and PHC facilities:** The pandemic has exposed the PHC system's fault-lines, and reforms and budget reallocations are necessary to address these weaknesses. There are, however, also concerns about the adequacy of our hospital infrastructure to withstand a second wave of COVID-19 infections. Given that we now have less immediate pressure and have a longer planning horizon, it is important to think strategically. In June, significant allocations were made to the establishment of field hospitals even as the rate of infections was declining. Much of the funding was directed from within the health budget, deepening existing biases towards expensive hospicentric care. However, a well-run health system with clear, cost-effective and well-functioning care pathways and well-maintained tertiary infrastructure does not require a large number of hospital beds, and will seldom have a large share of patients in ICUs.
- **Investment in mHealth and electronic patient management tools:** The experience gained during the pandemic has strengthened the case for leapfrogging with mHealth tools that can improve continuity of care and address barriers to access – including factors as wide-ranging as physical access and psychological barriers. This will also help to lighten the load on the health workforce. mHealth patient management tools and electronic patient communication channels will be a vital asset during future pandemics.
- **Disaster Management Regulations:** Based on the information available at the time, the decision to invoke the Disaster Management Regulations appeared sound. The lockdown initially planned for 21 days warranted the concentration of authority in the Executive. The establishment of a number of advisory councils was in line with the guidelines provided by the Act, but as consultative fora they could only advise, not direct. This is not to say that the advice was not followed, with government reporting that it accepted over 90% of the recommendations made. However, given the health and economic impact of the decisions taken, it would be useful for an independent evaluation of the implementation of the Disaster Management Act and subsequent regulations, including an evaluation of how risk assessments should be organized particularly in relation to the decision-making process.

Over the long-term, we need to invest in a **well-run, responsive and adaptive health system***, and* **continue to learn lessons** from this experience.

- **Invest in responsiveness of the health system:** The debate on the effectiveness and appropriateness of the country's containment and mitigation strategies will continue. The pandemic response has exposed the health system's strengths and its weaknesses. Health workers have shown tremendous courage and resilience, and the establishment of a parallel and fully integrated (public–private) real-time information system must be lauded. A comprehensive review of the responsiveness of the South African health system during the pandemic would be appropriate only at a later stage when more evidence has emerged, including research on the unintended consequences of the pandemic response.
- **Consider a conditional grant for strengthening PHC:** Addressing the sharp decline in service utilisation, particularly in strategic programmes such as HIV, TB and maternal and child health services and especially immunisation services, will require an explicit prioritisation of funding, which is difficult to accomplish within the current provincial funding allocation system. The best solution may be for such funding to be structured as a conditional grant, sourced via a reprioritisation of funds from the HIV/AIDS and TB grant, Human Resources for Health

capacitation grant, as well as the recently established COVID-19 conditional grant. Funding should be allocated on the premise of a needs-based district allocation formula.

- **Invest in more Community Health Workers (CHWs):** Many Community Health Workers have been trained in supporting maternal, neonatal and child health (and HIV and TB) service delivery, and they can help to take government health services into the home, as well as extending knowledge on COVID-19 and the enhanced risk for individuals with hypertension and diabetes. Short intensive training programmes should be developed to support CHWs for such an added role. Additional investments should be made to improve the co-ordination and supervision of CHW teams to ensure that interventions can be efficiently implemented. A public campaign outlining the services offered by outreach teams should be designed and launched to ensure that community service expectations are aligned with CHW capability. It is expected that this strategy can navigate a compromise and address the low PHC utilisation rate amid substantial fiscal constraints. This expansion of the scope of practice of CHWs should be carefully planned and well-monitored because there is a risk that the broader focus may come at the cost of effectiveness.

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Appendix

Appendix Table 1: Definitions of key indicators from District Health Information System

Indicator	Definition	Numerator	Denominator
PHC utilisation rate (total)	Average number of PHC visits per year per person in the population	PHC headcount - total	Total population
PHC utilisation rate (under 5 years)	Average number of PHC visits per year per person under 5 years of age in the population	PHC headcount under 5 years	Population under 5 years
Antenatal 1st visit before 20 weeks rate	Women who have a first visit before they are 20 weeks into their pregnancy as proportion of all antenatal 1st visits	Antenatal 1st visit before 20 weeks	Antenatal 1st visit – total
Couple year protection rate	Women protected against pregnancy by using modern contraceptive methods, (including sterilisations), as a proportion of female population 15-49 years	Couple year protection = (Oral pill cycles / 15) + (IUCD x 4.5) +(Medroxyprogesterone injection / 4) + (Norethisterone enanthate injection / 6) + (Sub dermal implant x 2.5) + Male condoms distributed / 120) + (Female condoms distributed / 120) + (Male sterilisation x 10) + (Female sterilisation x 10)	Female population 15–49 years
Immunisation under 1 year coverage	Children under 1 year who completed their primary course of immunisation as a proportion of population under 1 year	Immunised fully under 1 year	Population under 1 year
HIV tests done	Total number of HIV tests done in all age groups	HIV tests done (sum)	None
Inpatient (approved) bed utilisation rate	Inpatient bed days used as proportion of inpatient beds approved – total days (inpatient beds x days in period) available. Include all specialities	Inpatient days + ½-day patients	Inpatient beds approved – total bed days available
Patient Day Equivalent	Patient Day Equivalent – Total	Inpatient days total x 1 + (Day patient total x 0.5) + (OPD/Emergency total headcount x 0.3333)	None
Dataset completeness rate	National Indicator Data Set completeness rate	Number of facilities with NIDS dataset flag (scripted) completed	Number of open health facilities assigned to this dataset (measured on the 30th of the month)
Dataset timeliness rate	National Indicator Data Set timeliness rate	Number of facilities with NIDS dataset flag (scripted) completed by 10th of the month	Number of open health facilities assigned to this dataset

The proportion of the population covered by medical schemes per district was estimated using a small area model based on Census 2011, Community Survey 2016 and scaled using the General Household Survey 2018 and Council for Medical Schemes data. This estimate was then used with the population time series in the DHIS to calculate the uninsured population (Massyn, Pillay and Padarath, 2018; Massyn, Barron, Day, et al., 2020).

Appendix Table 2: First component scores, PCA for Census poverty index

Employed	0.2484
Unemployed	-0.0767
Discouraged worker	-0.111
Not economically active	-0.1257
No schooling	-0.1275
Some primary schooling	-0.1616
Secondary schooling	-0.0819
Completed secondary schooling	0.1848
Higher degree	0.266
Cell phone ownership	0.1977
Car ownership	0.2792
No income	-0.0046
R1–R4 800	-0.1092
R4 801–R9 600	-0.149
R9 601–R19 600	-0.1231
R19 601–R38 200	-0.0832
R38 201–R76 400	0.0483
R764 001–R153 800	0.205
R153 800–R307 600	0.2611
R307 600–R614 400	0.2648
R614 000–R1 228 800	0.2294
R1 228 800–R2 457 600	0.1781
R2 457 601 or more	0.1764
Unspecified	0.0412
One household member	0.0974
Two household members	0.2199
Three household members	0.16
Four household members	0.134
Five household members	-0.0615
Six household members	-0.1704
Seven household members	-0.1998
Eight household members	-0.1949
Nine household members	-0.1794
Ten household members	-0.1817

Appendix Table 3: NIDS-CRAM descriptive statistics

Variable	Count	%
Total	7 074	
Mean Age (Standard Deviation)	38.81 (15.43)	
Gender		
Man	2 754	38.9
Woman	4 314	60.9
Other	6	0.1
Population		
African/Black	6 048	85.5
Coloured	612	8.7
Asian/Indian	79	1.1
White	325	4.6
Other/Refuse/Don’t know	10	0.1
Income Quintile		
First Quintile	912	20.7
Second Quintile	1 047	23.8
Third Quintile	967	21.9
Fourth Quintile	884	20.0
Fifth Quintile	595	13.5
Education		
Grade R/No Schooling	398	5.6
Primary Education	982	13.9
Secondary Education	3 877	54.8
Tertiary Education	1 817	25.7
Experienced the following symptoms: sore throat, fever or cough		
Yes	615	8.7
No	6 396	90.4
Don’t know/Refused to answer	63	0.9
Experienced shortness of breath 4 weeks prior to the survey		
Yes	209	2.9
No	6 857	96.9
Don’t know/Refused to answer	8	0.11
Injuries 4 weeks prior to the survey		**0**
Yes	205	2.9
No	6 862	97.0
Don’t know/Refused to answer	7	0.1

Has health needs for a chronic condition		
Yes	1 613	22.8
No	5 447	77.0
Don't know/Refused to answer	14	0.2
Visits a health facility		
Yes	1 687	23.9
No	532	7.5
Refused to answer	5	0.1
Type of health facility visited		
Private doctor/Clinic	160	2.3
Private hospital	42	0.6
Public clinic	1 224	17.3
Public hospital	197	2.8
Pharmacy	45	0.6
Traditional healer	3	0.04
Other	10	0.1
Gets advice over the phone/Internet	1	0.01
Don't know/Refused to answer	5	0.1
Reason for not going to the clinic (if does not visit clinic)		
Afraid of the Defence Force/Police	4	0.1
Afraid of getting Coronavirus	30	0.4
Could postpone visit	16	0.2
Looking after children	4	0.1
No transport available	23	0.3
No transport money	13	0.2
Not ill enough to need care	191	2.7
Queues are too long	36	0.5
Too busy	23	0.3
Other/Refused to answer	192	2.7
Has access to medication, condoms and contraception		
Yes	1 919	27.1
No	5 121	72.4
Don't know/Refused to answer	34	0.5
Where individual has access to medication, condoms or contraception (if there is access)		
Private doctor/Clinic	72	1.0
Private hospital	19	0.3
Public clinic	1 322	18.7
Public hospital	179	2.5
Pharmacy	254	3.6

Other	38	0.5
Refused to answer/Don't know	35	0.5
Confirms to have one of the following: HIV, TB, lung condition, heart condition or diabetes		
Yes	1 524	21.5
No	5 521	78.0
Don't know/Refused to answer	29	0,41
Has medical aid		
Yes	1 111	15.7
No	5 942	84.0
Don't know/Refused to answer	21	0.3
Health needs for chronic condition by gender	**Man Count**	**Man %**
Yes, needs medication	492	17.9
No, does not need medication	2 256	81.9
Refused to answer/Don't Know	6	0.2
Total	**2 754**	**100**
Visits the clinic	**Man Count**	**Man %**
Yes	528	69.1
No	236	30.9
Total	**764**	**100**
Reason for not visiting the clinic	**Man Count**	**Man %**
Afraid of Defence Force/Police	3	1.3
Afraid of getting Coronavirus	9	3.8
Could postpone visit	4	1.7
Looking after children	2	0.8
No transport available	12	5.1
No transport money	4	1.7
Not ill enough to need care	86	36.4
Other/Refused to answer	84	35.6
Queues too long	15	6.4
Too busy	17	7.2
Total	**236**	**100**
Has access to medication	**Man Count**	**Man %**
Yes	665	24.1
No	2 074	75.3
Don't know	10	0.4
Refused to answer	5	0.2
Total	**2 754**	**100**

Appendix Table 4: MatCH descriptive statistics

Variable	Quintiles/Binary Quintiles	Count	%
Total		3 140	
Mean Age (Standard Deviation)		27 (5.5)	
Stage of pregnancy/age of baby			
Second trimester		298	9.5
Third trimester		612	19.5
0–6 months		1 068	34.0
6–12 months		1 162	37.0
MomConnect interaction			
WhatsApp		1 435	45.7
SMS		1 705	54.3
Province			
Eastern Cape		240	7.6
Free State		151	4.8
Gauteng		812	25.9
KwaZulu-Natal		587	18.7
Limpopo		499	15.9
Mpumalanga		375	11.9
North West		223	7.1
Northern Cape		39	1.2
Western Cape		214	6.8
When did you last go to the clinic or hospital?			
Before March		151	4.8
March		135	4.3
April		227	7.2
May		757	24.1
June		1 831	58.3
Don’t want to answer		39	1.2
Why didn’t you go to the clinic recently?			
Waiting time		53	10.3
Transport problems		31	6.0
Afraid of getting the Coronavirus		185	36.1
No need		149	29.0

Other	81	15.8
Don't want to answer/Don't know	14	2.8
During April, May and June, was there a child in your home who was sick or needed a vaccination?		
Yes	686	21.8
No	2 379	75.8
Don't want to answer/Don't know	75	2.4
Did the child see a nurse/doctor?		
Yes	648	94.5
No	35	5.1
Don't want to answer/Don't know	3	0.4
If you take ART, during May and June, have you run out of medication?		
Yes	175	5.6
No	1 435	45.7
Don't need ART	1 385	44.1
Don't want to answer/Don't know	145	4.6
Distribution of individuals who ran out of ART		
Ran out of ART	175	10.9
Did not run out of ART	1 435	89.1
Why did you run out of ART?		
Afraid of getting the Coronavirus	67	38.3
No ART available/Facility closed	35	20.0
Waiting time	25	14.3
Transport problems	36	20.6
Don't want to answer/Don't know	12	6.9
Has any adult in the household gone to bed hungry in the past 7 days?		
Yes	475	15.1
No	2 515	80.1
Don't want to answer	32	1.0
Left question out	118	3.8
Has any child in the household gone to bed hungry in the past 7 days?		
Yes	296	9.4
No	2 525	80.4
No child in the household	160	5.1
Don't want to answer/Don't know	159	5.1

Is anyone in your household receiving a Child Support Grant or an Old Age Pension?			
Yes		907	66.0
No		388	28.2
Don't want to answer/Don't know		79	6.0
In the last 7 days, have you felt hopeless, down or depressed?			
No		805	88.8
Yes, for a few days		91	10.0
Yes, for most days		6	0.7
Don't know		5	0.6
Mental health			
Okay		2 830	90.1
Not okay		111	3.5
Don't want to answer		199	6.3
Reason why the mom ran out of ART medication	**Quintile**		
Afraid of getting the Coronavirus	0–20%	21	32.3
	20–40%	10	15.4
	40–60%	14	21.5
	60–80%	6	9.2
	80–100%	14	21.5
Reason why the mom ran out of ART medication			
ART not available/Facility closed	0–20%	13	38.2
	20–40%	5	14.7
	40–60%	4	11.8
	60–80%	7	20.6
	80–100%	5	14.7
Reason why the mom ran out of ART medication			
Waiting time	0–20%	7	28.0
	20–40%	4	16.0
	40–60%	6	24.0
	60–80%	3	12.0
	80–100%	5	20.0

Reason why the mom ran out of ART medication			
Transport problems	0–20%	5	13.9
	20–40%	5	13.9
	40–60%	9	25.0
	60–80%	5	13.9
	80–100%	12	33.3
Reason why mom ran out of ART medication	**Binary Quintile**		
Afraid of getting the Coronavirus	0–40%	31	47.7
	0–100%	34	52.3
Reason why mom ran out of ART medication			
ART not available/Facility closed	0–40%	18	52.9
	0–100%	16	47.1
Reason why mom ran out of ART medication			
Waiting time	0–40%	11	44.0
	0–100%	14	56.0
Reason why mom ran out of ART medication			
Transport problems	0–40%	10	27.8
	0–100%	26	72.2
Reason why mom has not been to a health facility recently	**Quintile**		
Afraid of getting the Coronavirus	0–20%	46	26.6
	20–40%	38	22.0
	40–60%	27	15.6
	60–80%	31	17.9
	80–100%	31	17.9
Reason why mom has not been to a health facility recently			
Waiting time	0–20%	15	28.3
	20–40%	8	15.1
	40–60%	4	7.5
	60–80%	16	30.2
	80–100%	10	18.9

Reason why mom has not been to a health facility recently			
Transport problems	0–20%	10	35.7
	20–40%	7	25.0
	40–60%	2	7.1
	60–80%	2	7.1
	80–00%	7	25.0
Reason why mom has not been to a health facility recently			
There is no need	0–20%	17	11.9
	20–40%	26	18.2
	40–60%	32	22.4
	60–80%	25	17.5
	80–100%	43	30.1
Reason why mom has not been to a health facility recently	**Binary Quintile**		
Afraid of getting the Coronavirus	0–40%	84	48.6
	0–100%	89	51.4
Reason why mom has not been to a health facility recently			
There is no need	0–40%	43	30.1
	0–100%	100	69.9
Reason why mom has not been to a health facility recently			
Waiting time	0–40%	23	43.4
	0–100%	30	56.6
Reason why mom has not been to a health facility recently			
Transport problems	0–40%	17	60.7
	0–100%	11	39.3

Appendix Table 5: Weighted mean health care utilisation, by province: January 2018 to August 2020

	PHC utilisation rate (total)	PHC utilisation rate (<5 years)	Immunisation coverage (<1 year)	ANC 1st visit before 20 weeks	CYPR	Total HIV tests	Inpatient Bed Utilisation rate	Patient Day Equivalent
E.Cape	**2.18**	**2.89**	**72.34**	**64.23**	**51.86**	**22,206.53**	**60.76**	**49,580.41**
	(0.03)	(0.04)	(0.97)	(0.55)	(1.15)	(584.21)	(0.65)	(1,381.65)
Free State	**1.79**	**2.98**	**75.32**	**64.88**	**74.61**	**11,805.70**	**64.26**	**44,531.79**
	(0.02)	(0.04)	(0.69)	(0.34)	(2.49)	(453.09)	(1.28)	(3,225.28)
Gauteng	**1.44**	**2.76**	**84.03**	**64.96**	**49.47**	**80,350.37**	**80.98**	**159,590.39**
	(0.02)	(0.05)	(0.78)	(0.29)	(1.75)	(4,191.70)	(1.33)	(4,573.75)
KwaZulu-Natal	**2.39**	**3.31**	**90.47**	**73.51**	**54.44**	**52,721.67**	**62.81**	**98,723.67**
	(0.03)	(0.05)	(0.99)	(0.23)	(1.35)	(4,031.45)	(0.51)	(7,422.04)
Limpopo	**2.33**	**4.22**	**72.51**	**67.77**	**55.95**	**26,805.89**	**72.02**	**50,412.80**
	(0.03)	(0.06)	(0.94)	(0.40)	(1.50)	(572.11)	(0.66)	(1,137.73)
Mpumalanga	**1.98**	**3.62**	**93.15**	**74.82**	**51.38**	**38,876.31**	**60.69**	**51,814.86**
	(0.06)	(0.09)	(1.34)	(0.65)	(2.71)	(1,855.93)	(0.91)	(2,090.13)
N. Cape	**2.15**	**4.09**	**87.31**	**63.98**	**56.22**	**5,185.25**	**56.25**	**11,614.25**
	(0.03)	(0.06)	(1.28)	(0.56)	(2.13)	(162.14)	(1.04)	(784.77)
North West	**1.86**	**3.14**	**66.74**	**69.27**	**56.57**	**28,053.16**	**73.11**	**32,529.87**
	(0.03)	(0.05)	(1.50)	(0.37)	(1.85)	(1,415.20)	(0.70)	(1,290.00)
W.Cape	**2.03**	**3.58**	**83.79**	**70.40**	**67.62**	**59,089.68**	**83.34**	**175,216.07**
	(0.05)	(0.08)	(1.04)	(0.48)	(2.03)	(4,332.24)	(0.91)	(10,728.25)
Sample	**1664**	**1664**	**1664**	**1664**	**1664**	**1664**	**1654**	**1664**

*Source: DHIS. Standard errors in parentheses. ** p<0.05, ***p<0.01. Where: PDE is Patient Day Equivalent, ANC = antenatal care, PHC = Primary Health Care, CYPR = Couple Year Protection Rate*

Appendix Table 6: Correlations of district-level service utilisation during lockdown

	PHC utilisation	PHC utilisation <5 years
Second-poorest quintile	-0.023	-0.0046
Third-poorest quintile	-0.023	0.020
Second-most affluent quintile	-0.086	-0.058
Most affluent quintile	-0.16	-0.11
Metro	0.16	0.14
District population share	-1.26	-1.17
PHC expenditure per PHC headcount	0.00025	0.000058
Professional Nurses per 100 000 population	0.000019	-0.0011
Medical Practitioners per 100 000 population	-0.00085	0.0022
Public sector hospital beds per 10 000 target pop	-0.0043	-0.0045
District hospital beds per 10 000 target pop	0.011	0.017*
COVID-19 prevalence June 2020	0.000011	0.00007
Data completeness average score	0.0021	0.0021
Data submission timeliness average score	-0.0011	-0.00034

Source: DHIS. * p<0.05, **p<0.01

Appendix Table 7: Provincial differences in service utilisation decreases during lockdown

	PHC utilisation	*PHC utilisation < 5 year*	*Immunisation coverage <1 year*	*Early access to ANC*	*Couple year protection rate*	*HIV testing*
EC	*-0.11*	*-0.13*	*-0.053*	*0.060*	*0.12*	*0.00010*
GP	*-0.21***	*-0.25***	*-0.077*	*0.077*	*-0.081*	*-0.11***
KZ	*-0.13*	*-0.20***	*-0.070*	*0.073*	*0.16*	*0.0073*
LP	*-0.12*	*-0.16*	*-0.051*	*0.082*	*-0.094*	*-0.024*
MP	*-0.17*	*-0.17*	*-0.075*	*0.032*	*-0.25***	*-0.0038*
NC	*-0.14*	*-0.19***	*-0.12*	*0.033*	*0.24*	*-0.029*
NW	*-0.062*	*-0.094*	*-0.0048*	*-0.014*	*-0.040*	*-0.0030*
WC	*-0.30****	*-0.25****	*-0.043*	*0.11***	*0.18*	*-0.12*

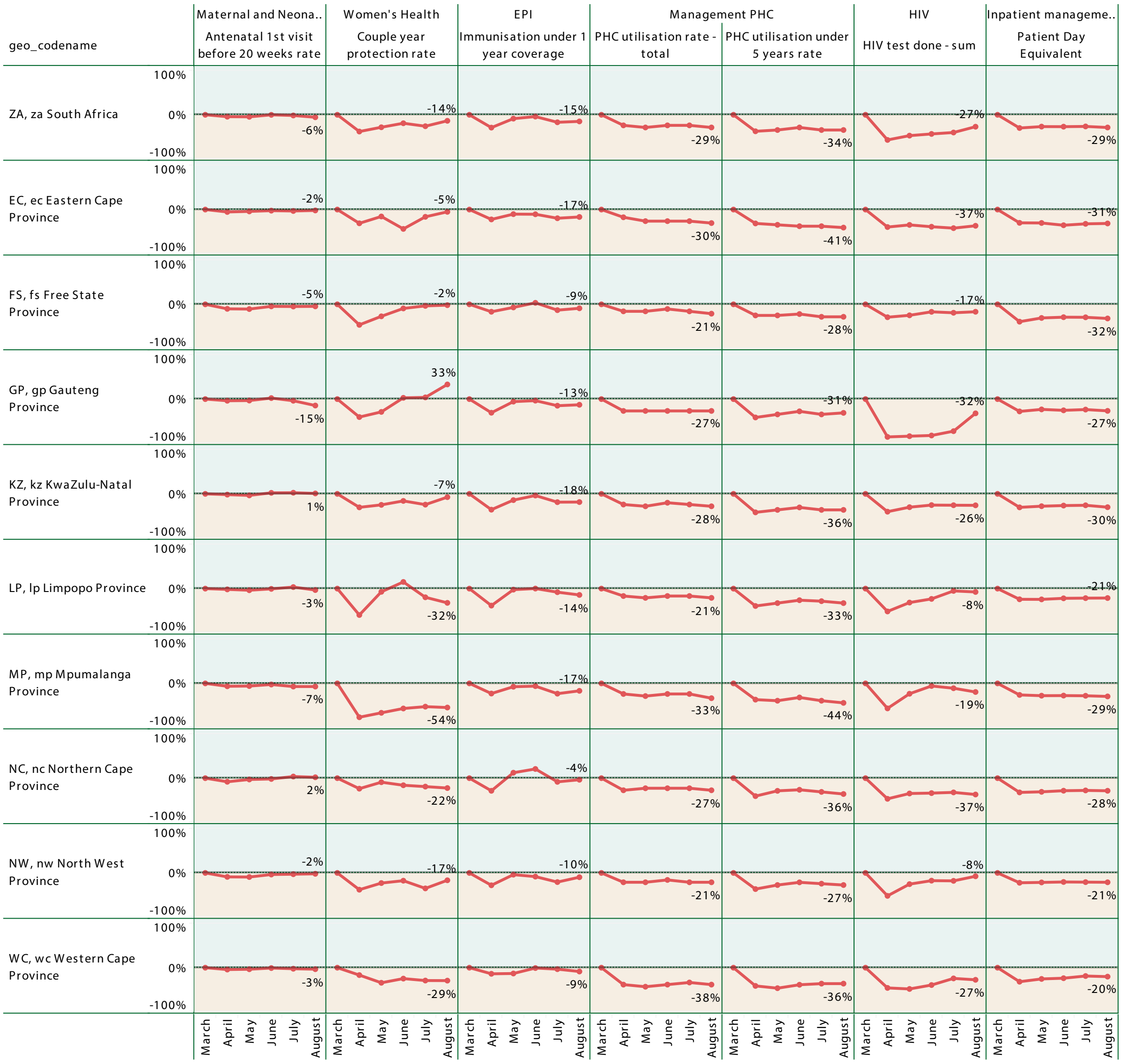
Source: DHIS. ** p<0.05, ***p<0.01

Appendix Figure 1: District level trends for 2020 on a fixed scale, across six services

Maternal and Neona..
Antenatal 1st visit before 20 weeks rate
Women's Health
Couple year protection rate
EPI
Immunisation under 1 year coverage
Management PHC
PHC utilisation rate - total
PHC utilisation under 5 years rate
HIV
HIV test done - sum
Inpatient manageme..
Patient Day Equivalent
GP
TSH, gp City of Tshwane Metropolitan Municipality
-17% 10% -9% -26% -30% -18% -33%
KZ
DC21, kz Ugu District Municipality
3% -18% -23% -37% -18% -28%
DC22, kz uMgungundlovu District Municipality
1% -47% -37% -35% -42% -33% -35%
DC23, kz Uthukela District Municipality
-2% -83% -18% -25% -37% -38% -19%
DC24, kz Umzinyathi District Municipality
-7% -9% -23% -33% -40% -34% -34%
DC25, kz Amajuba District Municipality
5% -39% -21% -25% -39% -31% -31%
DC26, kz Zululand District Municipality
-4% 89% -19% -30% -38% -28% -30%
DC27, kz Umkhanyakude District Municipality
3% -72% -20% -26% -33% -22% -21%
DC28, kz King Cetshwayo District Municipality
8% 16% -18% -28% -34% -24% -36%
DC29, kz iLembe District Municipality
1% 59% -10% -20% -33% -15% -36%
DC43, kz Harry Gwala District Municipality
-8% 70% -17% -33% -44% -21% -27%
ETH, kz eThekwini Metropolitan Municipality
2% -17% -13% -30% -35% -25% -30%
LP
DC33, lp Mopani District Municipality
5% -29% -18% -21% -32% -3% -19%
DC34, lp Vhembe District Municipality
2% -9% -14% -22% -38% -10% -25%
DC35, lp Capricorn District Municipality
-23% -33% -14% -14% -22% 4% -19%
DC36, lp Waterberg District Municipality
3% -32% -22% -22% -35% -24% -28%
DC47, lp Sekhukhune District Municipality
0% -52% -5% -18% -31% -20% -18%
MP
DC30, mp Gert Sibande District Municipality
-16% -60% -17% -44% -53% -31% -31%
100%
0%
-100%
March
April
May
June
July
August


geo..
geo_codename
Maternal and Neona..
Antenatal 1st visit before 20 weeks rate
Women's Health
Couple year protection rate
EPI
Immunisation under 1 year coverage
Management PHC
PHC utilisation rate - total
PHC utilisation under 5 years rate
HIV
HIV test done - sum
Inpatient manageme..
Patient Day Equivalent
100%
0%
-100%
MP
DC31, mp Nkangala District Municipality
-2% -79% -23% -31% -35% -31% -34%
DC32, mp Ehlanzeni District Municipality
-10% -51% -17% -30% -44% -15% -31%
NC
DC6, nc Namakwa District Municipality
-4% -41% -12% -29% -45% -38% -22%
DC7, nc Pixley ka Seme District Municipality
5% 43% -13% -29% -33% -42% -44%
DC8, nc Zwelentlanga Fatman Mgcawu District Municipality
0% -31% -6% -20% -26% -23% -27%
DC9, nc Frances Baard District Municipality
-4% 13% 6% -22% -36% -24% -68%
DC45, nc John Taolo Gaetsewe District Municipality
12% -51% -12% -27% -38% -56% -36%
NW
DC37, nw Bojanala Platinum District Municipality
-5% 6% -18% -24% -27% 4% -22%
DC38, nw Ngaka Modiri Molema District Municipality
-3% -38% 11% -25% -30% -25% -24%
DC39, nw Dr Ruth Segomotsi Mompati District Municipality
-4% -58% -7% -26% -24% -23% -37%
DC40, nw Dr Kenneth Kaunda District Municipality
5% 9% -23% -28% -31% -8% -17%
WC
CPT, wc City of Cape Town Metropolitan Municipality
-7% -25% -9% -45% -36% -14% -17%
DC1, wc West Coast District Municipality
9% -23% 6% -33% -31% -31% -34%
DC2, wc Cape Winelands District Municipality
-2% -32% -16% -33% -42% -43% -28%
DC3, wc Overberg District Municipality
2% -57% 15% -37% -33% -50% -37%
DC4, wc Garden Route District Municipality
1% -39% -18% -39% -47% -43% -27%
DC5, wc Central Karoo District Municipality
-2% 24% -38% -36% -33% -52% -12%
March April May June July August

Appendix Figure 2: Provincial level trends for 2020 on a fixed scale, across six services



Appendix B: Assessing effect of "hard" lockdown: significance and robustness of results

We investigate the effect of the "hard" lockdown on health care utilisation using all available data from January 2018 to August 2020. Note that the coefficients of these regressions are not directly comparable to the effect size shown the out-of-sample analysis in Table 2.

Appendix B1 starts with a pooled analysis with a range of controls, including province, month of the year and a time trend, including a quadratic and cube time trends. Appendix Table B2 investigates the robustness of the significance of the lockdown month dummy (April/May 2020) to various specifications of the time trend terms (quadratic, cube). In both cases the variable of interest is a dummy for April and May 2020, representing the "hard" lockdown period.

Appendix Table B3 examines whether data completeness was affected by the pandemic, controlling for province, metropolitan area, and for a non-linear trend in data completeness over time. The results (in column 1) demonstrate that there are large differences in data completeness by province and over time from January 2018 to May 2020, all else being equal, but there is no significant association between the lockdown period and data completeness scores at the district level. Thus, it is unlikely that the reduction in healthcare utilisation observed in April and May 2020 (and reported in the main body of the report) is mainly an artefact of reduced reporting in these periods. The latter is an important concern for the researchers and for readers because if PHC facilities became overwhelmed with work or were affected by staff shortages, one would expect it to affect the quality and completeness of data capturing. By contrast, there is a significant association with timeliness. Fortunately, slight delays in uploading routine data are unlikely to affect our analysis.

Appendix Table B4 report on a range of robustness tests and further investigations. The regression was run unweighted; as a fixed effects panel regression; including the timeliness variable as an explanatory variable and excluding the districts (Amajuba and iLembe) and the province (KwaZulu-Natal) with the most missing data. Across all these specifications, the coefficient on the dummy variable for April and May 2020 remains negative and this variable is associated with reduced utilisation across all healthcare indicators. Although only the results for the variable PHC utilisation (total) are reported here, the lockdown dummy also remained robust for the other healthcare utilisation indicators. The consistency and robustness of the results to changes in the regression specification increases our confidence in the results

The results of the regression analysis were lastly also shown to be robust to the introduction of a lagged independent variables of the outcome variable (at one, two, three and four months) in Appendix Table B5. The first row of the table (labelled "No Lag") represents the specification reported in the main body of the report. Across all these specifications, the coefficient on the dummy variable for April and May 2020 remains negative and significant (either at the 0.01 or 0.05 level, as indicated by respectively *** or **).

Appendix Table B1: OLS regression results: Pooled analysis: January 2018 to August 2020

	PHC utilisation rate	Immunisation coverage <1 year	ANC 1st visit <20 weeks	CYPR	PHC utilisation rate <5 years	Total HIV tests (log-scale)	PDE (log-scale)	Inpatient bed utilisation rate
Lockdown level 4,5: April, May 2020	**-0.28*****	**-10.38*****	**-1.70****	**-6.27****	**-0.82*****	**-0.67*****	**-0.19*****	**-11.09*****
	(0.04)	(1.89)	(0.73)	(2.47)	(0.08)	(0.10)	(0.06)	(2.40)
Eastern Cape	**0.26*****	**-21.89*****	**-9.51*****	**4.73***	**-0.67*****	**-0.93*****	**-0.56*****	**-1.10**
	(0.06)	(1.50)	(0.86)	(2.63)	(0.08)	(0.07)	(0.06)	(1.00)
Western Cape	**0.18*****	**-11.73*****	**-2.05*****	**25.57*****	**0.08**	**-0.66*****	**-0.26*****	**19.90*****
	(0.06)	(1.42)	(0.72)	(2.78)	(0.08)	(0.06)	(0.06)	(1.70)
Free State	**-0.13****	**-18.90*****	**-8.87*****	**27.46*****	**-0.58*****	**-1.57*****	**-0.89*****	**2.40***
	(0.06)	(1.35)	(0.71)	(3.42)	(0.08)	(0.08)	(0.05)	(1.39)
Gauteng	**-0.37*****	**-12.27*****	**-6.70*****	**10.54*****	**-0.70*****	**-0.42*****	**-0.31*****	**16.70*****
	(0.06)	(1.42)	(0.73)	(2.84)	(0.09)	(0.06)	(0.05)	(3.16)
KwaZulu-Natal	**0.48*****	**-3.93*****	**-0.06**	**7.96*****	**-0.25*****	**-0.37*****	**-0.25*****	**0.76**
	(0.06)	(1.32)	(0.67)	(2.61)	(0.08)	(0.05)	(0.04)	(1.03)
Limpopo	**0.35*****	**-20.64*****	**-7.05*****	**4.57***	**0.61*****	**-0.33*****	**-0.00**	**11.32*****
	(0.06)	(1.47)	(0.74)	(2.63)	(0.09)	(0.05)	(0.04)	(0.88)
Northern Cape	**0.17*****	**-5.85*****	**-10.84*****	**4.84**	**0.47*****	**-2.00*****	**-1.70*****	**-4.44*****
	(0.06)	(1.57)	(0.82)	(3.09)	(0.08)	(0.05)	(0.08)	(1.20)
North West	**-0.13****	**-26.42*****	**-5.55*****	**5.19***	**-0.48*****	**-0.38*****	**-0.51*****	**12.42*****
	(0.06)	(1.90)	(0.70)	(2.92)	(0.08)	(0.07)	(0.05)	(0.92)
Metropolitan area	**-0.21*****	**3.60*****	**-3.61*****	**-14.22*****	**-0.17*****	**1.19*****	**1.60*****	**3.93****
	(0.02)	(0.79)	(0.33)	(1.31)	(0.03)	(0.04)	(0.03)	(1.95)
January	**0.37*****	**6.67***	**0.37**	**-6.48**	**0.48*****	**0.55*****	**0.23**	**3.56**
	(0.10)	(4.01)	(1.53)	(7.84)	(0.18)	(0.15)	(0.14)	(5.51)
February	**0.43*****	**5.86**	**2.25**	**7.58**	**0.67*****	**0.55*****	**0.18**	**0.21**
	(0.10)	(3.66)	(1.44)	(7.70)	(0.17)	(0.15)	(0.13)	(5.16)
March	**0.32*****	**2.14**	**2.81****	**-1.29**	**0.54*****	**0.46*****	**0.22***	**5.07**
	(0.09)	(3.15)	(1.33)	(6.67)	(0.16)	(0.14)	(0.12)	(4.82)
April	**0.26*****	**-2.78**	**1.63**	**-12.12****	**0.38****	**0.34*****	**0.13**	**1.89**
	(0.08)	(2.94)	(1.23)	(5.87)	(0.15)	(0.13)	(0.11)	(3.86)
May	**0.30*****	**5.93****	**0.87**	**-8.38**	**0.53*****	**0.42*****	**0.17**	**4.49**
	(0.08)	(2.65)	(1.12)	(5.48)	(0.14)	(0.12)	(0.10)	(3.55)

June	**0.10**	**2.65**	**1.40**	**-8.29***	**0.13**	**0.15**	**0.06**	**-1.16**
	(0.07)	(2.32)	(1.05)	(4.80)	(0.12)	(0.11)	(0.09)	(3.90)
July	**0.15*** **	**-0.12**	**1.75***	**-5.34**	**0.11**	**0.21****	**0.09**	**0.97**
	(0.06)	(2.13)	(0.95)	(4.35)	(0.11)	(0.10)	(0.08)	(3.64)
August	**0.13****	**-2.21**	**1.13**	**-0.64**	**0.18***	**0.30*****	**0.09**	**5.93*****
	(0.05)	(1.81)	(0.80)	(3.97)	(0.10)	(0.09)	(0.08)	(1.56)
September	**0.04**	**-2.94***	**1.48****	**0.88**	**0.12**	**0.07**	**0.04**	**1.36**
	(0.05)	(1.58)	(0.70)	(3.74)	(0.08)	(0.08)	(0.07)	(1.46)
October	**0.14*****	**5.48*****	**1.32****	**0.69**	**0.25*****	**0.14***	**0.07**	**3.62*****
	(0.05)	(1.65)	(0.62)	(3.09)	(0.08)	(0.08)	(0.06)	(1.09)
December	**-0.56*****	**-16.21*****	**-2.34*****	**-15.53*****	**-0.83*****	**-0.46*****	**-0.11***	**-3.26*****
	(0.04)	(1.46)	(0.68)	(3.09)	(0.07)	(0.07)	(0.06)	(1.19)
Years: 2018 to 2020	**-0.50*****	**-4.63**	**-4.33****	**-2.79**	**-0.59*****	**-0.70*****	**-0.28**	**-3.44**
	(0.12)	(4.73)	(1.87)	(9.39)	(0.22)	(0.19)	(0.17)	(6.79)
Months squared: Jan. 2018 to July 2020	**0.00*****	**0.06****	**0.05*****	**0.01**	**0.01*****	**0.01*****	**0.00****	**0.05**
	(0.00)	(0.03)	(0.01)	(0.05)	(0.00)	(0.00)	(0.00)	(0.05)
Months cubed: Jan. 2018 to July 2020	**-0.00*****	**-0.00*****	**-0.00*****	**-0.00**	**-0.00*****	**-0.00*****	**-0.00*****	**-0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	**2.27*****	**95.35*****	**75.58*****	**64.43*****	**3.90*****	**10.60*****	**10.91*****	**61.98*****
	(0.08)	(2.50)	(1.06)	(5.36)	(0.13)	(0.10)	(0.09)	(2.56)
R-squared	**0.703**	**0.512**	**0.468**	**0.323**	**0.677**	**0.704**	**0.804**	**0.352**
Sample	**1664**	**1664**	**1664**	**1664**	**1664**	**1664**	**1664**	**1654**

Source: DHIS. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Where: Mpumalanga & November are omitted categories for dummy variables.

Table B2: Alternative specifications of time trend in the OLS pooled analysis: PHC utilisation rate (total): January 2018 to August 2020

	month dummies	linear trend	quad.trend	cubed trend
Lockdown level 4,5: April, May 2020	**-0.39*** **	**-0.29*** **	**-0.21*** **	**-0.23*** **
	(0.05)	(0.04)	(0.04)	(0.04)
Eastern Cape	**0.26*** **	**0.26*** **	**0.26*** **	**0.26*** **
	(0.06)	(0.06)	(0.06)	(0.06)
Western Cape	**0.18*** **	**0.18** **	**0.18*** **	**0.18*** **
	(0.07)	(0.07)	(0.07)	(0.07)
Free State	**-0.13** **	**-0.13** **	**-0.13** **	**-0.13** **
	(0.06)	(0.06)	(0.06)	(0.06)
Gauteng	**-0.37*** **	**-0.37*** **	**-0.37*** **	**-0.37*** **
	(0.06)	(0.06)	(0.06)	(0.06)
KwaZulu-Natal	**0.48*** **	**0.48*** **	**0.48*** **	**0.48*** **
	(0.06)	(0.06)	(0.06)	(0.06)
Limpopo	**0.35*** **	**0.35*** **	**0.35*** **	**0.35*** **
	(0.06)	(0.06)	(0.06)	(0.06)
Northern Cape	**0.17*** **	**0.17** **	**0.17*** **	**0.17*** **
	(0.06)	(0.07)	(0.06)	(0.06)
North West	**-0.13** **	**-0.13** **	**-0.13** **	**-0.13** **
	(0.06)	(0.06)	(0.06)	(0.06)
Metropolitan area	**-0.21*** **	**-0.21*** **	**-0.21*** **	**-0.21*** **
	(0.02)	(0.02)	(0.02)	(0.02)
January	**0.04**			
	(0.04)			
February	**0.12*** **			
	(0.04)			
March	**0.02**			
	(0.04)			
April 2018, 2019 or 2020	**0.01**			
	(0.04)			
May 2018, 2019 or 2020	**0.07**			
	(0.04)			
June	**-0.16*** **			
	(0.04)			

July	**-0.09****			
	(0.04)			
August	**-0.11****			
	(0.05)			
September	**-0.03**			
	(0.04)			
October	**0.11****			
	(0.04)			
December	**-0.53*****			
	(0.04)			
Years: 2018 to 2020	**-0.13*****			
	(0.01)			
Months: January 2018 to August 2020		**-0.01*****	**0.02*****	**-0.05*****
		(0.00)	(0.00)	(0.01)
Non-linear time trend: months squared			**-0.00*****	**0.00*****
			(0.00)	(0.00)
Non-linear time trend: months cubed				**-0.00*****
				(0.00)
Constant	**2.30*****	**2.22*****	**2.03*****	**2.23*****
	(0.07)	(0.06)	(0.06)	(0.07)
R-squared	**0.664**	**0.599**	**0.623**	**0.637**
Sample	**1664**	**1664**	**1664**	**1664**

Source: DHIS. *Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

Appendix Table B3: OLS (pooled analysis): National Indicator Data Set completeness and timeliness rate: May 2018 to August 2020

	Data completeness	Timeliness of reporting
Lockdown level 4,5: April, May 2020	**-0.12**	**-4.84****
	(1.43)	(1.97)
Eastern Cape	**7.19*****	**26.96*****
	(0.67)	(1.63)
Gauteng	**4.43*****	**23.83*****
	(1.17)	(1.93)
KwaZulu-Natal	**-34.54*****	**-12.57*****
	(1.31)	(1.72)
Limpopo	**6.03*****	**19.87*****
	(0.73)	(1.80)
Northern Cape	**6.48*****	**14.93*****
	(0.67)	(1.94)
North West	**0.17**	**10.16*****
	(1.00)	(1.73)
Metropolitan area	**-2.41****	**-3.75*****
	(1.12)	(1.17)
Months: January 2018 to August 2020	**-1.23**	**2.18***
	(0.80)	(1.30)
Non-linear time trend: months squared	**0.13*****	**0.00**
	(0.05)	(0.07)
Non-linear time trend: months cubed	**-0.00*****	**-0.00**
	(0.00)	(0.00)
Constant	**89.69*****	**25.68*****
	(3.90)	(6.91)
R-squared	**0.721**	**0.630**
Sample	**1288**	**1288**

Source: DHIS. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Sample: All districts, except Western Cape. Mpumalanga is the omitted category for province.

Appendix Table B4: Effect of alternative specifications of regression on beta coefficients on lockdown dummy variable and R-squared

	PHC utilisation (total)	PHC utilisation (< 5 years)	CYPR	ANC 1st visit < 20 weeks	Immunisation coverage (< 1 year)	HIV tests (log-scale)	Inpatient bed utilisation	PDE (log-scale)
Unweighted regression	**-0.30*****	**-0.81*****	**-4.87**	**-2.33*****	**-9.70*****	**-0.47*****	**-11.00*****	**-0.19****
	(0.05)	(0.07)	(3.12)	(0.74)	(1.46)	(0.08)	(2.17)	(0.08)
	0.553	0.619	0.259	0.417	0.447	0.647	0.293	0.683
Including timeliness	**-0.27*****	**-0.76*****	**-7.58*****	**-1.88****	**-9.33*****	**-0.69*****	**-10.62*****	**-0.16****
	(0.04)	(0.08)	(2.69)	(0.80)	(1.94)	(0.12)	(2.76)	(0.06)
	0.748	0.716	0.330	0.471	0.546	0.698	0.295	0.806
Exclude KZN	**-0.28*****	**-0.81*****	**-5.57****	**-1.51***	**-8.93*****	**-0.76*****	**-11.76*****	**-0.19*****
	(0.05)	(0.09)	(2.66)	(0.87)	(1.86)	(0.12)	(3.11)	(0.07)
	0.682	0.709	0.362	0.400	0.489	0.690	0.315	0.795
Exclude Ilembe & Amajuba	**-0.28*****	**-0.82*****	**-6.10****	**-1.69****	**-10.32*****	**-0.68*****	**-11.13*****	**-0.19*****
	(0.05)	(0.08)	(2.52)	(0.75)	(1.92)	(0.10)	(2.46)	(0.06)
	0.716	0.687	0.324	0.460	0.509	0.708	0.346	0.804
Fixed Effects Panel	**-0.28*****	**-0.82*****	**-6.27*****	**-1.70*****	**-10.38*****	**-0.67*****	**-11.02*****	**-0.19*****
	(0.03)	(0.07)	(2.11)	(0.51)	(1.60)	(0.10)	(2.26)	(0.01)
	0.780	0.807	0.237	0.271	0.375	0.487	0.133	0.808

Source: DHIS. *Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

Appendix Table B5: Effect of inclusion of lagged effects in regressions: Coefficients on lockdown dummy variable and R-squared

		PHC utilisation (total)	PHC utilisation (< 5 years)	CYPR	ANC 1st visit < 20 weeks	Immunisation coverage (< 1 year)	HIV tests (log-scale)	Inpatient bed utilisation rate	PDE (log-scale)
No Lag	**Lockdown level 4,5: April, May 2020**	**-0.28*****	**-0.82*****	**-6.27*****	**-1.70*****	**-10.38*****	**-0.67*****	**-11.02*****	**-0.19*****
		(0.03)	(0.07)	(2.11)	(0.51)	(1.60)	(0.10)	(2.26)	(0.01)
		0.780	0.807	0.237	0.271	0.375	0.487	0.133	0.808
1 Lag	**Lockdown level 4,5: April, May 2020**	**-0.32*****	**-0.79*****	**-5.39****	**-1.08***	**-9.72*****	**-0.58*****	**-10.37*****	**-0.17*****
		(0.04)	(0.06)	(2.14)	(0.54)	(1.48)	(0.10)	(2.44)	(0.01)
		0.832	0.843	0.267	0.385	0.400	0.723	0.146	0.871
2 Lags	**Lockdown level 4,5: April, May 2020**	**-0.36*****	**-0.88*****	**-5.48****	**-1.19****	**-10.61*****	**-0.64*****	**-11.09*****	**-0.21*****
		(0.04)	(0.06)	(2.08)	(0.57)	(1.55)	(0.12)	(3.14)	(0.01)
		0.841	0.849	0.251	0.389	0.408	0.727	0.146	0.883
3 Lags	**Lockdown level 4,5: April, May 2020**	**-0.36*****	**-0.88*****	**-5.81****	**-1.21****	**-10.67*****	**-0.62*****	**-10.79*****	**-0.22*****
		(0.04)	(0.06)	(2.38)	(0.57)	(1.83)	(0.11)	(2.68)	(0.02)
		0.858	0.863	0.260	0.394	0.429	0.735	0.145	0.889
4 Lags	**Lockdown level 4,5: April, May 2020**	**-0.37*****	**-0.87*****	**-6.78****	**-1.10***	**-9.76*****	**-0.57*****	**-10.65*****	**-0.21*****
		(0.04)	(0.06)	(2.71)	(0.60)	(2.00)	(0.11)	(2.85)	(0.01)
		0.864	0.868	0.271	0.395	0.438	0.745	0.153	0.890

Source: DHIS. Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

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