



South African
ACTUARY

COVID-19 SUPPLEMENT

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MICHAEL TICHAREVA

This supplement is a special edition that focuses on the Covid pandemic. The pandemic has brought with it much suffering among families and communities who

have lost their loved ones, and who have suffered in pain during illness. One life lost is one too many, as every life lost represents someone's partner, child, parent, friend, neighbour or colleague!

Economies have also not been spared, with mitigating measures such as lockdowns reducing productivity and introducing uncertainty in the future economic trajectory of individual countries and the World at large. The businesses and communities in which actuaries deliver services have, therefore, also been affected. The divide between the wealthy and the poor, the haves and the have nots, has become even more apparent, indicating the need for a new normal, and actuaries have a big role to play in that new normal.

In an attempt to counter the devastating effects of the Covid pandemic, governments, non-governmental organisations, and the private sector across the World have had to come together in a coordinated fashion to find lasting solutions, with a number of vaccines having now been approved for emergency purposes, and one such vaccine having now received full approval in the US. The speed at which vaccines have been developed and approved in response to the pandemic has been remarkable, indicating the advances in science and medical practice over the last century.

There remains debate among various experts and practitioners in a number of areas around Covid as countries rollout their Covid mitigation strategies, including vaccine roll out. Some have argued whether vaccines are effective or even necessary, opting to rely on natural immunity. Vaccine hesitancy lingers, and one may actually consider it to be another pandemic on top of a pandemic, depending on what one believes. Others have even doubted if covid is real until it has visited their door steps and taken a life.

The articles in this Covid supplement of the SA Actuary are high quality articles from actuaries who have been closer to the action. They provide answers to some of the issues we are grappling with as we seek to understand the impact of Covid and the various interventions to date. Data collection and analysis still continue, but we need more time to fully appreciate the impact of decisions that have been taken to date in dealing with the Covid pandemic. There is already a lot of work that has been undertaken, and continue to be undertaken, to fully understand the impact of covid and the different interventions that include vaccine rollout.

We trust that you enjoy reading this covid supplement and formulate your views. We will continue to provide coverage on the Covid pandemic as more data comes to light, and as time progresses. In the face of uncertainty, only the passage of time will prove whether we have been on the right track or not, and whether we showed real thought leadership in designing solutions that solve problems that we face each day.

Until next time, please stay safe! 🇿🇦

Michael Tichareva

Lead Editor, on behalf of the Editorial Team

If you wish to comment or contribute to The SA Actuary, please send your contributions to SAactuary@actuarialsociety.org.za

THE LOCAL VACCINE PROGRAMME IN FOUR ACTS

- Barry Childs, Joint CEO, Insight

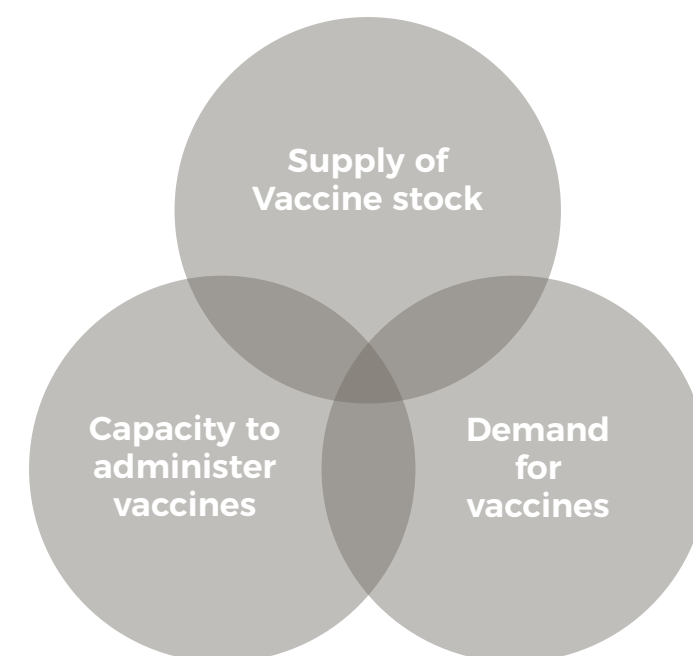
This article presents a summary narrative of the vaccine programme so far. It does not cover all of the drama of the project, but merely outlines the key themes and highlights of the eventful endeavour, as I experienced during my involvement in the programme rollout.

OVERTURE

South Africa's Covid-19 vaccine programme has been at once a monumental logistical campaign and a balancing act of regulations, politics, and resource constraints. The drive to get a large portion of the adult population vaccinated is part of the worldwide effort to resume normal daily life without (or with far fewer) restrictions on movement, social gathering, mask wearing and other interventions put in place to try and slow the spread and effect of SARS-COV2 and Covid-19.

The local vaccine programme has gone through distinct phases dictated by a constraint on one of the 3 forces determining the number of vaccines administered.

The National Department of Health (NDoH) began negotiating with vaccine manufacturers in late 2020. This got off to very slow start for which resulted in much public and political outcry as other countries were seen to be getting delivery of vaccines earlier than South Africa. Nonetheless due process took its course with procurement and delivery agreements eventually reached. There was much debate over vaccine types, with local scientists involved in efficacy and safety trials on various different vaccines. Controversially, the Astra Zeneca vaccine was rejected for local use which also delayed the vaccine rollout.



ACT 1 - MEDICAL EMERGENCY

Healthcare workers were prioritised for initial rollout of the vaccines, but since no commercially procured stock was available locally, the Sisonke Trial was initiated under the auspices of the Medical Research Council whereby Johnson & Johnson's single dose vaccine was made available as research stock at no cost for public and private healthcare workers. This initial phase of the vaccine rollout involved tremendous effort of both public and private sectors. Vaccine sites were identified, staff trained, research protocols finalised, and logistics arranged. The Electronic Vaccine Data System (EVDS) made its first appearance after circa 3 weeks of development.

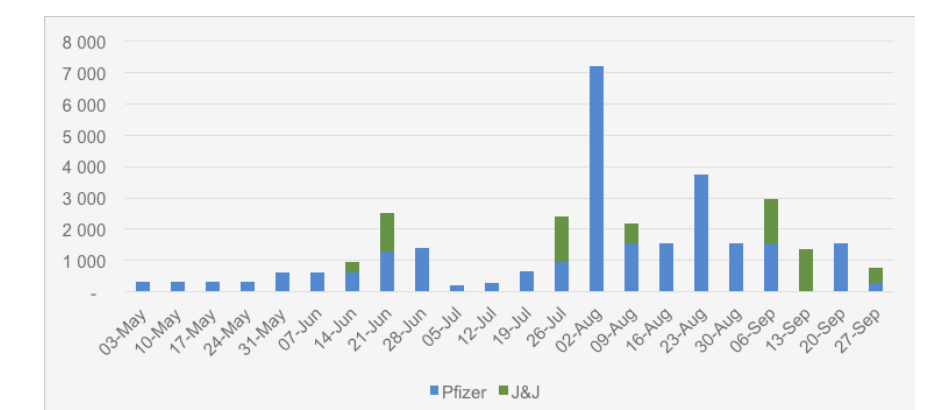
Business For South Africa (B4SA) has been the principal mechanism for Business in general and the private health sector in particular for engagement with the NDoH. Through the B4SA forum extensive collaboration between private hospitals and other private sector stakeholders took place to arrange the necessary processes and systems to register healthcare workers for the Sisonke trial. I was asked to assist private hospitals and other segments of the market bulk upload employee information into the EVDS system, with all of the accompanying privacy and confidentiality provisions in place in order to speed up the process of scheduling vaccines. In those early days many niggles were experienced and dealt with as the kinks in the systems were worked on. The GPs showed great leadership and initiative in launching the Vaccines for Healthcare Workers site and functionality which provided a mechanism for individual healthcare professionals (such as doctors and allied professionals) to upload their details and schedule vaccine appointments. Between the public and private health sectors an estimate of 1 million healthcare workers was used in public conversation, although my own estimates would put this figure closer to 700,000.

One of the early lessons in this phase of the vaccine programme was the folly of too much bureaucracy and fine tuning of prioritisation and rules. People found ways to work around rules which in turn caused additional workload of the already strained teams working on the programme. There were long debates about front line healthcare workers versus admin and support staff also working in proximity of patients. In the end everyone eligible was afforded the opportunity to get their shot in good time, but the debates and queue jostling were fierce. Towards the end of the Sisonke trial, there were enough doses available and eligibility criteria were loosened to a very broad definition of healthcare worker, including researchers, or just about anyone involved in supporting the health system. The healthcare worker phase of the vaccine rollout was widely regarded as a success and effective trial run for the broader population rollout in terms of the required systems, logistics and general readiness.

While the Sisonke trial was ongoing, work on procuring doses, and getting SAHPRA (South African Health Products Regulatory Authority) approval was

ongoing. Researchers and policymakers focused on a mix of Johnson & Johnson and Pfizer vaccines. During this time there was a global race for vaccine procurement with wealthier countries winning out, to the detriment of poorer countries. Equity in vaccine availability became a major global health policy topic. COVAX, a coalition buying group working for global equity in vaccine distribution working with the WHO and other partners was supposed to secure early access to sufficient vaccine stock for lower income countries. South Africa participated in this coalition, but ultimately COVAX procurement processes and stock were slow in realisation and while participation helped overall stock levels, the process did not speed up access to vaccines.

Vaccine doses delivered into South Africa per week ('000)



Only in August 2021 after receiving a large shipment of Pfizer vaccines did stock shortages alleviate and allow capacity and demand to become the next constraints.

ACT 2 - GROUNDWORK

While vaccine supply was being arranged, EVDS was being (re)developed to move past the Sisonke Trial and run the registration process for the wider population. This involved (among others) two separate developments; (1) the vaccine registration system for individuals wanting to register to get a vaccine and (2) building up of the NDoH's Master Facility List (MFL) which would be a master list of all sites to deliver vaccines. This MFL was to be much broader than the vaccine sites used to administer vaccines during the Sisonke Trial. Much debate ensued among policymakers and other stakeholders regarding prioritised eligibility. Prioritisation was a key

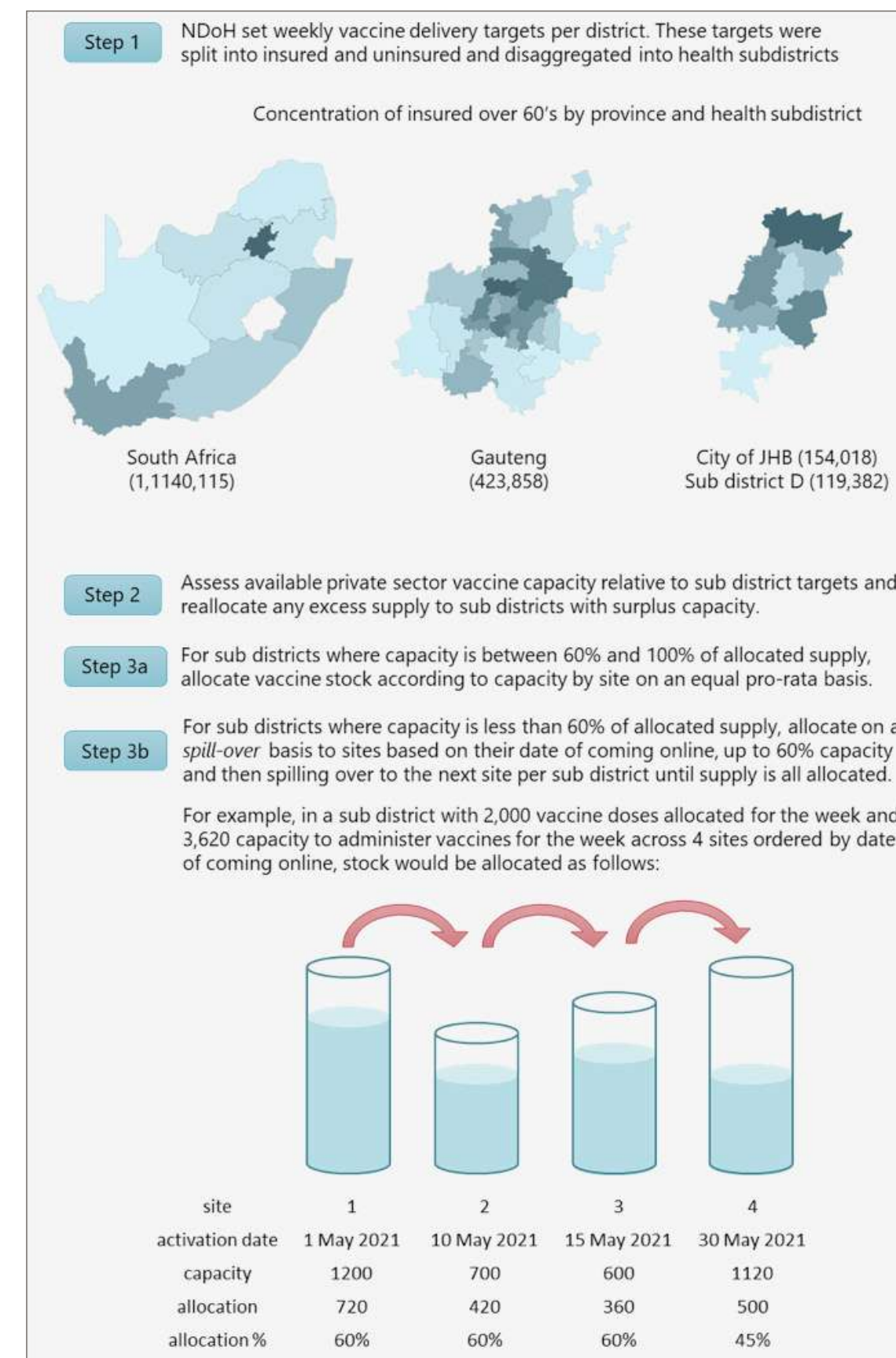
issue due to the limited supply of vaccine that had initially been secured. Aspects of the debate included age, gender, exposure to risk (front line staff with high contact rates versus isolated staff working from home for example), and comorbidities. The debate settled on age-based prioritisation for administrative simplicity. Later in the vaccine program, certain interest groups managed to secure specific access to batches of vaccine, for example the initiative for teachers and tertiary educators.

Public sector sites to deliver vaccines were assigned based on provincial plans, submitted to NDoH for approval. Private sector sites were called for via the B4SA forum from hospitals, pharmacies, and other healthcare stakeholders. Each site went through the administratively burdensome process of capturing their proposed vaccine site on the MFL and waiting for the application to be vetted. There were extensive policy debates about what the policy should be for so called cross-vaccinations – insured (medical scheme) patients getting vaccinated at public sites, and uninsured patients getting vaccinated at private sites. The pricing for vaccines was also the subject of contentious discussion and was only finalised just as the program was about to go live. Would the private sector be paying more than the public sector? Would there be a direct cross subsidy between the sectors? Who exactly would the private sector be buying the vaccine from, since the NDoH had secured national purchasing rights and precluded any parallel purchasing of vaccine?

Early deliberations amongst the private sector site committees had set a target of the private sector bringing sufficient capacity to effectively deliver half of the vaccine jabs delivered nationally. This proved difficult to achieve for a variety of reasons. Private hospital groups that had played a key role in vaccine delivery in the Sisonke Trial wound down some of their vaccine delivery capacity to focus on treating Covid-19 patients requiring hospital care as the third wave took hold. The MFL system turned out not to be well suited to accommodate the loading of GP practices as 'facilities' without there being an equivalent of the 'pharmacy council' to vet GP applications. As a result, registration of GPs never really got off the ground despite widespread efforts all around. So called workplace sites for mines and other

interested entities were also slow to get registered. Pharmacies and large sites set up by some medical scheme administrators became the main body of private sector vaccine delivery. Again, the issue of equity arose in terms of where vaccine capacity would be opened. Medical scheme membership and even corporate pharmacies are concentrated in urban areas. The situation that arose then was one of surplus capacity to deliver vaccine in urban areas, and insufficient capacity to deliver vaccines in rural areas. At the same time, since vaccine supply was low, sites in urban areas were running at low levels of their available capacity, making the commercial viability questionable. At this stage of the vaccine program, allocation of available stock became a critical discussion point.

The first question of allocation was how much to allocated between the public and private sectors. Issues of fairness and equity were raised, as well as the issue of cross-vaccinations and how and when fees would flow for these. Initially the rules set were that 15% of vaccine stock (based loosely on the proportion of the population belonging to a medical scheme) would be allocated to the private sector, and a limit of 5% vaccines per private site were allocated for uninsured individuals. This kept the volume of vaccine stock going to private sites very low, and well below operationally break-even levels. B4SA successfully argued that the proportion of the insured population at older ages was higher than 15%, and after the few weeks of the over 60-vaccine programme being rolled out, private sector allocation was increased to 23% of available stock. This still meant much lower stock allocated than available private sector capacity. Again the challenge of stock allocation became a priority, this time within the private sector. For the first few weeks of the programme, private sector stock was allocated on a simple pro-rata basis of aggregate orders placed to available stock. This created discrepancies by region and private sector group. As an independent stakeholder, I was asked to develop an allocation model trading off regional equity and vaccine operational efficiency. The model structure manifest as follows:



This process ensured the optimal balance between equity and operational efficiency, with the added advantage of encouraging private groups to open sites in areas with low capacity and discouraging new sites opening in areas with more than sufficient capacity. Any surplus unallocated stock was reallocated within the district, and then province, and then back to public sites. Each week data was collected from private sites on their open sites (and site locations),

J&J vaccine was earmarked for rural areas since it was thought it would be difficult to bring people in sparsely populated areas back on schedule for a second dose. However, it proved more difficult than anticipated to secure sufficient J&J stock which also slowed down vaccine delivery in rural areas. Second doses of Pfizer began to be scheduled complicating logistics and vaccine allocation as second doses were prioritised over first doses to remain in line

and capacity. Data capture was largely a manual process as the necessary detail on the MFL was not kept up to date by groups. There were times when sites ran out of stock as demand exceeded supply, and patients were asked to return at later dates.

ACT 3 – BUILDING PACE

During August 2021 the vaccine stock pipeline began to expand as procurement pressure bore fruit. Availability of stock ceased to become a key constraint. For a while, the programme was still driven by regional targets and the allocation process followed was as described above but with a higher proportion of orders from vaccine sites being fulfilled. Pressure also started to build on widening eligibility criteria to younger age groups. Despite efforts to balance out rural and urban sites, varying regional access to healthcare facilities meant urban areas showed faster rates of vaccination and insured individuals were also vaccinated at faster rates than the uninsured. The strict rules on uninsured patients being vaccinated at private sites began to loosen, and gradually the allocation of vaccines to private sites was increased to around 30% in line with overall private sector capacity. The single dose

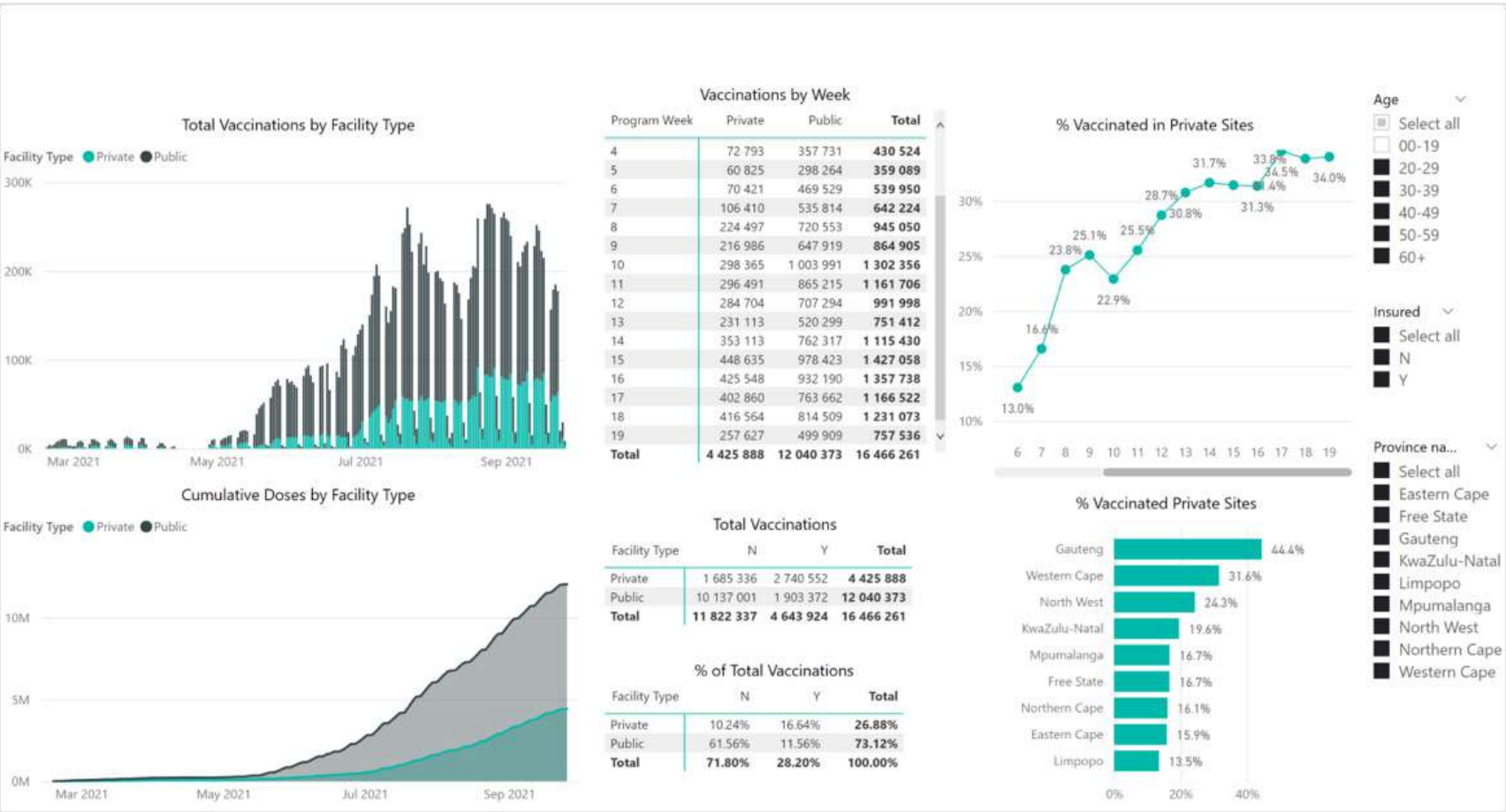
with determined protocols. EVDS continued to be developed and further refined to accommodate the ever-growing rule set of allocations to areas, queuing, and scheduling. Early signs of demand drop off for the over 60 and 50-60 age groups raised concern over the risk of missing targets. This led to earlier opening of the younger age group (35-50) and then to all adults being eligible.

The rules for pre-registration and waiting your turn to be scheduled were eventually relaxed to allow walk-ins as sites and provinces yielded to on-the-ground pressure. All rules for where and when a person got their shot were eventually relaxed in efforts to smooth out the cumbersome process and make it easy to just get vaccinated.

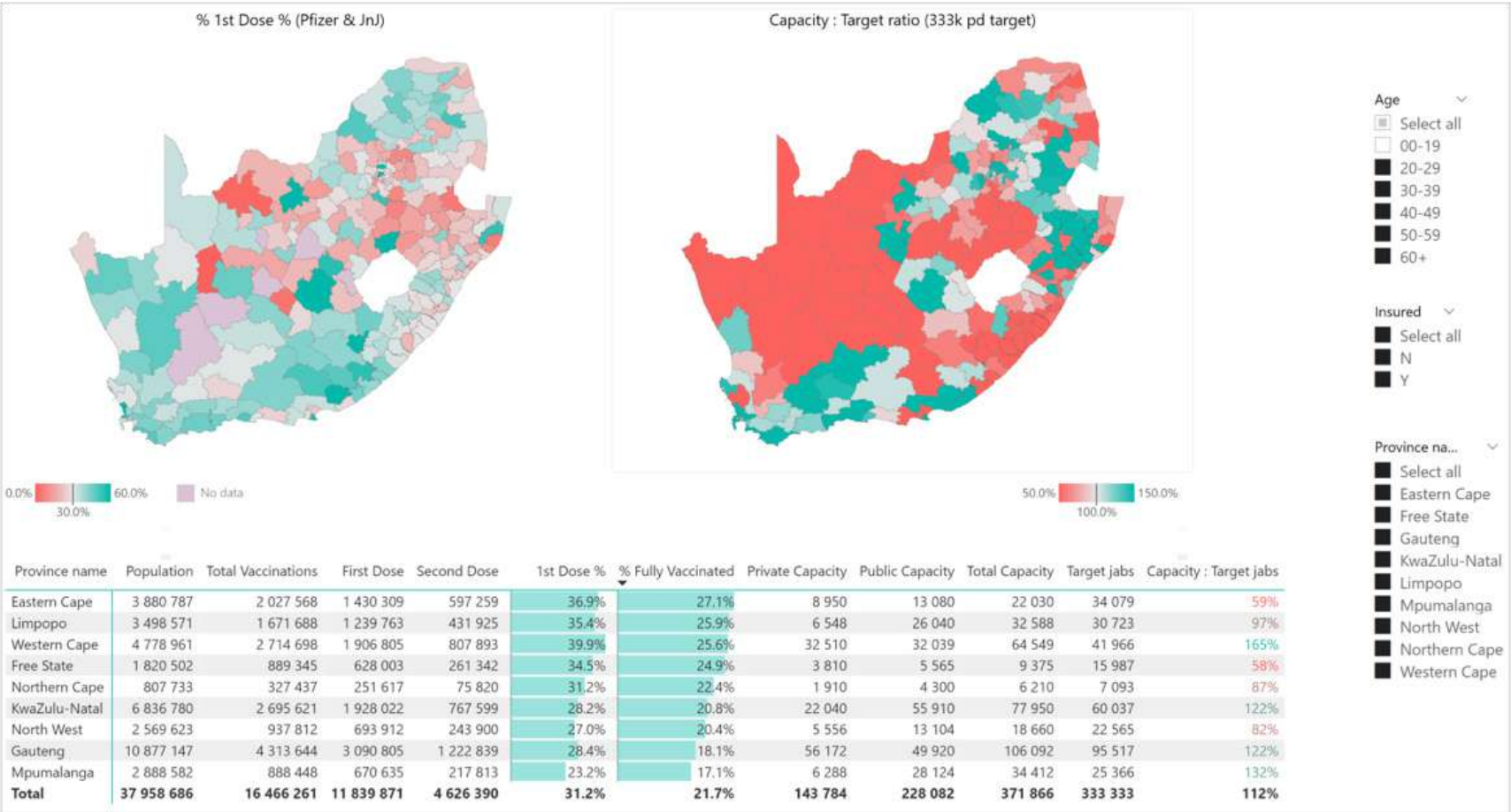
The programme focus was still on ensuring there was sufficient capacity to deliver vaccines at the desired pace, with NDoH setting a target of

1 million vaccines every four days. This was difficult to maintain as the majority of sites were still (and remain even now) closed on weekends. The same regional analytical approach was followed to identify areas where more capacity was needed, measured against the overall NDoH target pro-rata for each sub district. These dashboards were updated on a weekly basis alongside vaccine throughput statistics to delineate drivers of delivery between capacity issues and demand issues. Additional capacity was brought online at some employer sites and so-called outreach sites which are intended to bring vaccines to the people. Successful examples were a project to administer vaccines at SASSA pay-points and sites set up at taxi ranks. Overall volumes of vaccine delivery were maintained near the national target with the private sector gradually building up to deliver over 30% of administered vaccines including to a growing number of uninsured.

Vaccine programme monitoring by Public/Private (to 26 September)



Vaccine programme weekly monitoring dashboard by region (to 26 September).

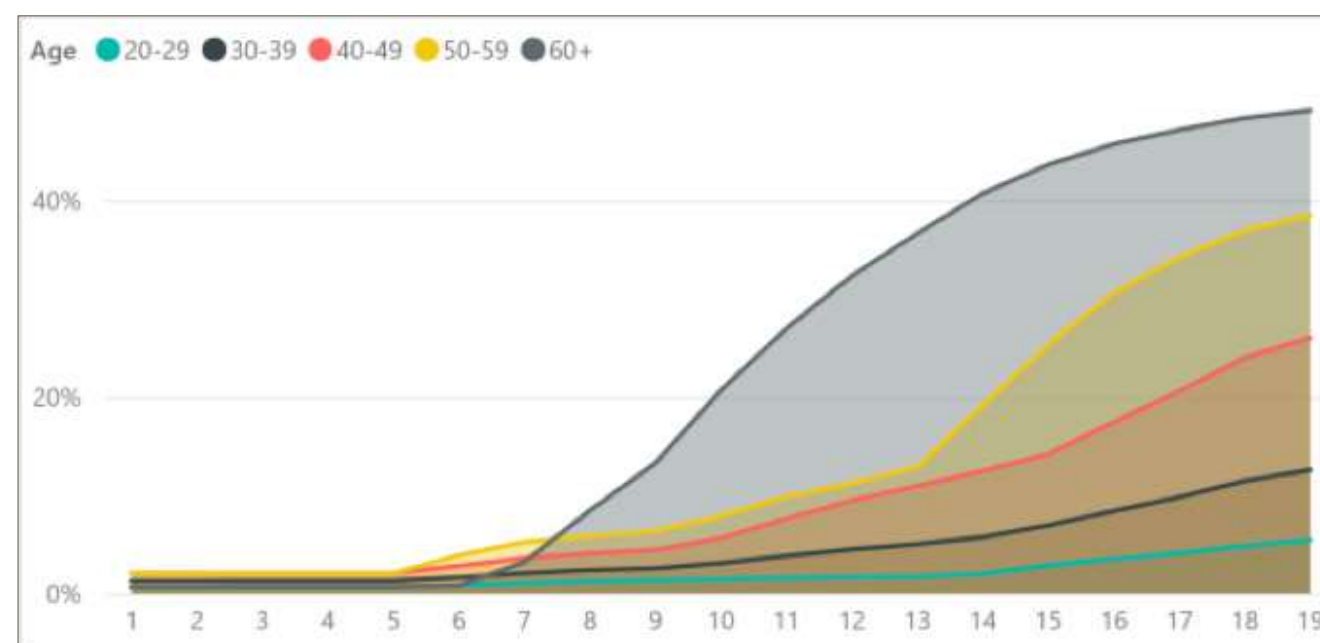
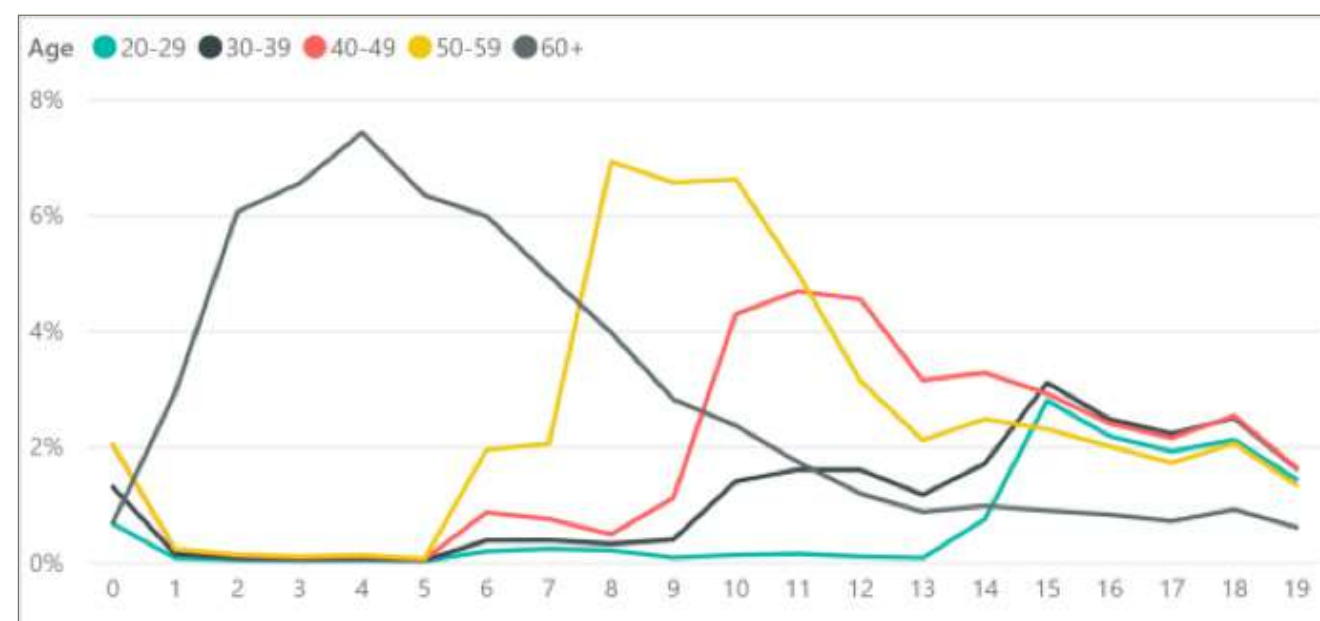


ACT 4 – A RACE TO THE FINISH

As demand began to drop for the 50-60 age group and even the 35-50 age group, the 18-35 age group was opened for eligibility earlier than expected. This gave a large initial burst of volume due to the large number of people in this age group and some pent-up demand. By this stage of the programme, vaccine supply was ample, and there was sufficient capacity between public and private sectors to deliver vaccines at the target pace, barring some of the more rural districts. The problem had become one of demand. Drop off in demand for vaccine started occurring earlier than expected for younger age groups. The over 60 group were plateauing near 60% vaccinated, lower than the targeted 70% or ideal 80% level. While some research has been done to better understand the drop off, a thorough understanding remains elusive. Some reasons include inconvenience for younger working age

groups, but it is also clear that there is a strong anti-vaccine or vaccine hesitancy constituent in South Africa, as we have also seen in other parts of the world. People are suspicious of the apparent speed with which vaccines were developed and rolled out, the initial emergency rather than full approval of the vaccines by the FDA (some have since become fully approved), the lack of long-term testing etc. Billions of vaccine doses have been administered globally with vanishingly small side effects and complication rates however the issue remains a divisive one. Locally some employers have made getting the vaccine compulsory. Internationally we have seen vaccine passports come into play with some countries permitting access to sporting events (for example) only for those with vaccine passports or recent proof of being Covid-19 negative, whereas other countries with high (enough) vaccination rates are beginning to lift all social restrictions.

Proportion of age group getting first vaccine dose by programme week (up to 15 September)



Cumulative fully vaccinated by age group by programme week (up to 15 September 2021)

We can expect a race to get vaccine doses administered before they expire including increased pressure from some quarters for compulsion or stronger coercion as well as expansion of eligibility to younger ages (currently SAHPRA have approved the use of Pfizer for those 11 and older). Technically a number of challenges persist, including the agreements required to allow appropriate funding flows between public and private sectors for cross vaccinations. Data sharing remains something of a challenge as data is held tightly by NDoH. Data shared with the private sector for analysis, planning and monitoring is summarised with age bands that do not match the ages specified for eligible groups making accurate analysis difficult. Nonetheless the cooperation between public and private sectors for the programme as a whole has been remarkable to be part of, and despite the various challenges faced along the way, the South African Covid-19 vaccine programme will make its required contribution to returning our way of life back to normal, or as close as we can get. 🚫

COVID-19:

Actuarial Society of South Africa COVID-19 Working Group – September 2021

POTENTIAL FOURTH WAVE SCENARIOS FOR SOUTH AFRICA

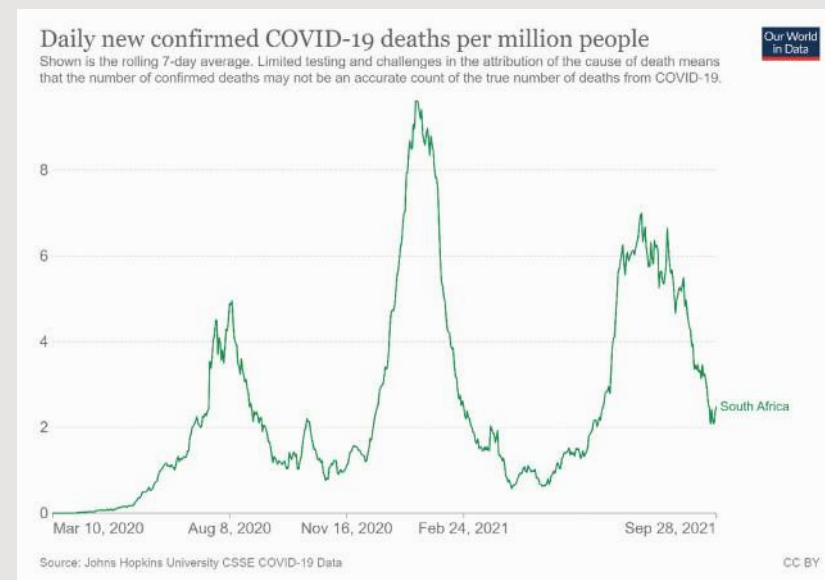


As the world grapples with the COVID-19 pandemic, a pattern of 'waves' of infection appears to be developing in many countries. For South Africa, a first wave of infections was recorded in July/August 2020, with a second wave following in December 2020 and extending into January 2021 and a third wave starting in July 2021 and extending into August and even September. The country has recently exited the third wave of infections, and already talk has started to turn to what the shape of a potential fourth wave might look like.

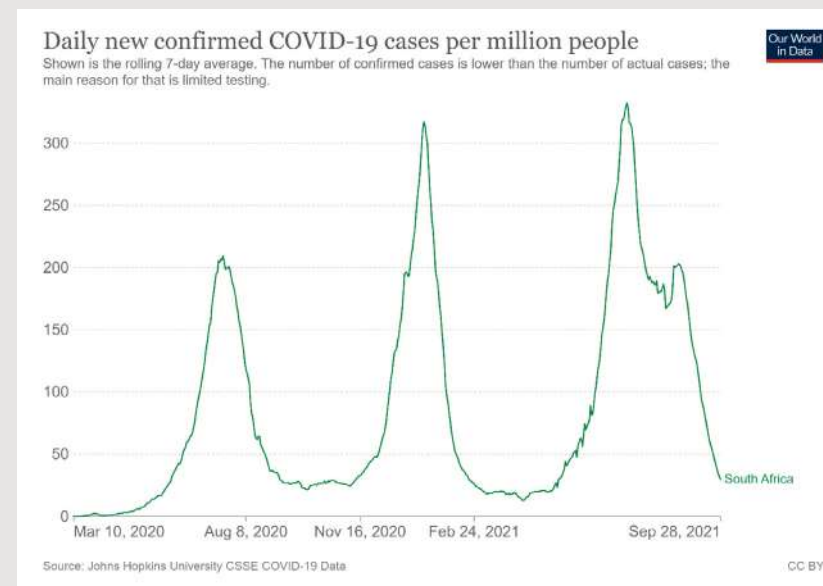
As the world grapples with the COVID-19 pandemic, a pattern of 'waves' of infection appears to be developing in many countries. For South Africa, a first wave of infections was recorded in July/August 2020, with a second wave following in December 2020 and extending into January 2021 and a third wave starting in July 2021 and extending into August and even September. The country has recently exited the third wave of infections, and already talk has started to turn to what the shape of a potential fourth wave might look like.

The ideal method of tracing the virus' progression through a population would be by counting the total number of active infections and producing a trend over time. However, testing regimes vary dramatically across countries, and even in those with high testing rates it appears a large number of more mild cases are never captured in the case statistics. This creates inconsistency and a lack of reliability in the total case numbers. As such, the most common way of tracking trends in the virus has been either through deaths of patients infected with the virus or by counting the numbers of severe cases (usually those admitted to hospital after being diagnosed with COVID-19).

The trends in COVID-19 infections for South Africa are shown in the graph below, using confirmed deaths as a tracking indicator. The graph shows the smaller first wave, larger second and third wave pattern which South Africa has experienced during 2020 and into 2021. It also shows the slower exit from the third wave compared to the second.



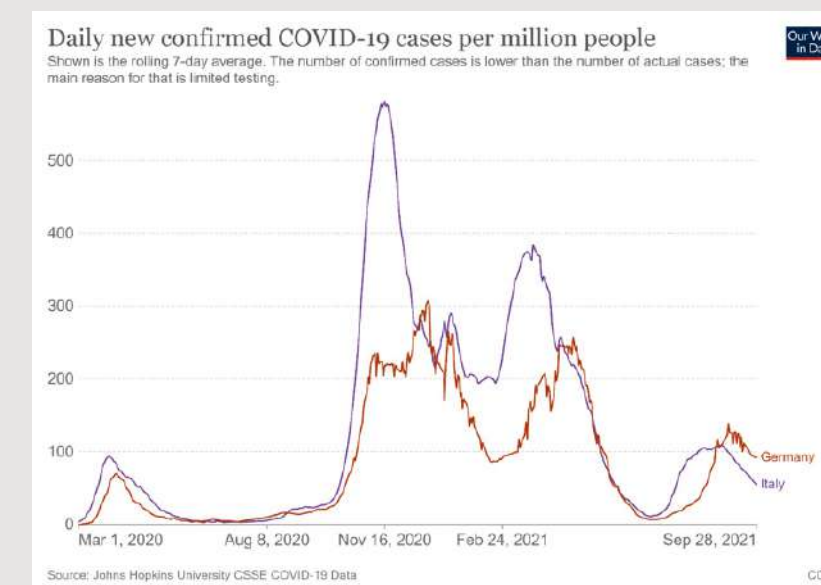
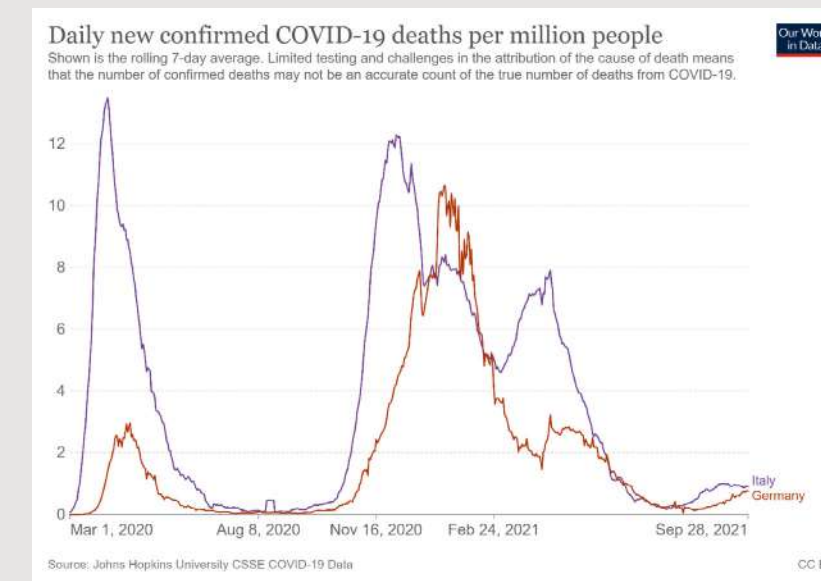
The next chart shows the confirmed cases trend over time. While the cases number is dependent on testing regimes etc. it is also a useful way of tracking the progression of the virus through the population, especially when comparing a country to itself (which can standardize the effects of the external variables as long as a consistent testing and tracing regime is followed). The graph shows that for the third wave, while the deaths peak did not reach the levels of the second wave, the infection numbers did, and in fact, exceeded the second wave peak. The reasons for this difference are not fully understood at this stage, but it is likely that the vaccination programme as well as repeat infections have played a role.



EVIDENCE FROM OTHER COUNTRIES' THIRD WAVES¹

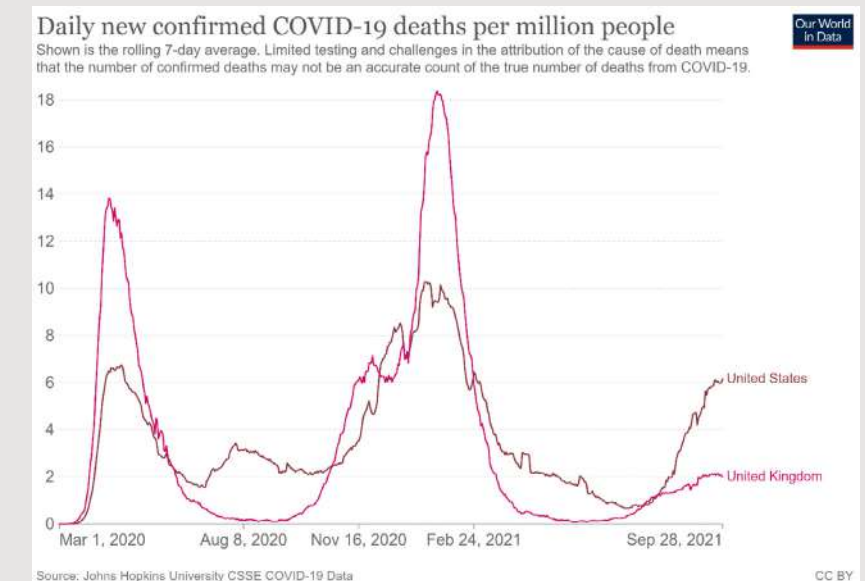
This section summarises the third wave experiences of other selected countries in the world. While it is still too early to use any of these patterns to predict the likely nature of any fourth wave, given the circumstances the countries faced, some of them may be informative of potential futures for South Africa.

In this section, the same trends in deaths and cases over time as shown for South Africa in the introduction are shown for three sets of other countries. The first set shows two European countries (Italy and Germany) which entered into third waves earlier than South Africa.



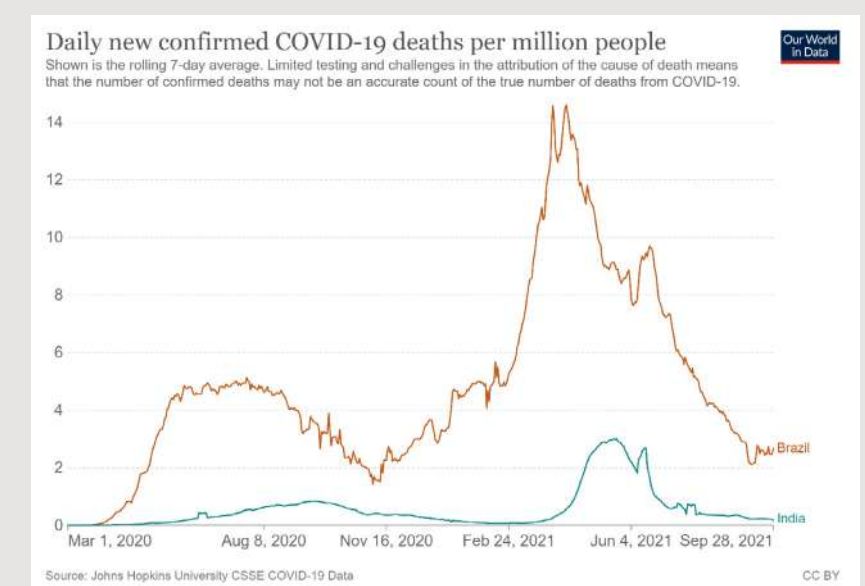
The charts show that both countries had third waves of lower magnitude than their second waves, and already appear to be experiencing the start of fourth waves. However, while Italy's third wave showed a similar pattern for both deaths and cases, Germany's did not. Both appear to have entered a fourth wave, but haven't seen large peaks in either cases or deaths yet.

The next pair of countries are the United Kingdom and the United States which had relatively large-scale vaccine rollouts within their populations before the onset of their third wave, and which started to release lockdown restrictions once the vaccine rollout was sufficiently far-reaching.

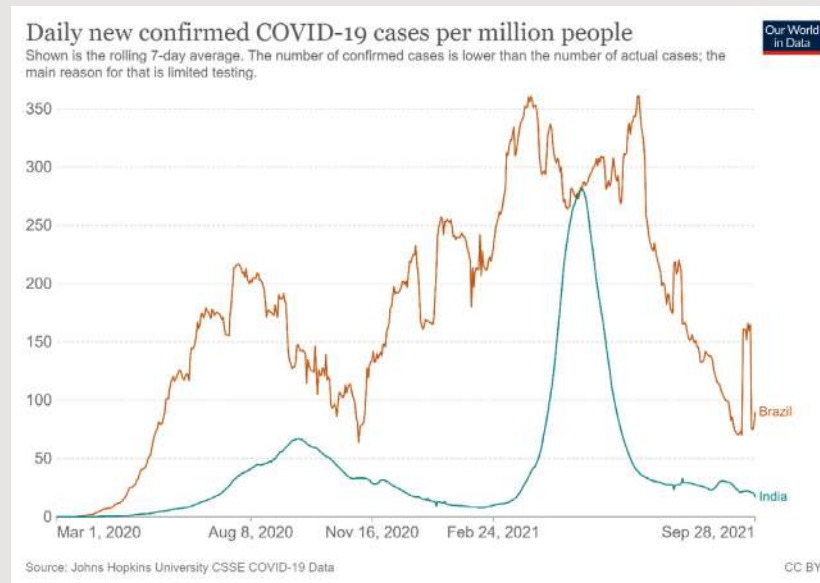


The patterns for both countries show relatively large case numbers in the third waves, and while the United States shows a muted third wave of deaths, the United Kingdom deaths have remained at a very low level and only show some minor uptick late in September. This appears to demonstrate the potential impact that vaccination can have in managing the rates of severe infection and death even in a population where the virus continues to spread.

The final pair of countries are the two countries which have been amongst the hardest hit by the virus, namely India and Brazil (both of which have at various stages reported large surges in cases). These two countries also appear to be out of sync with the wave patterns in the rest of the world.



¹ The graphics in this section were created using data published on the 'Our World in Data' platform created by the Oxford Martin Project on Global Development (<https://ourworldindata.org/coronavirus>)



The patterns for these two countries appear to have been out of sync with the rest of the world, with both seemingly experiencing one very large infection wave and other more minor 'blips' unlike the previous countries where discernable waves were evident in the pattern.

It is most likely too early for the evidence from other countries to be used as a guide for what the South African experience may be since none appear to even all cases) shows the pattern of a smaller first wave followed by a larger second and third wave. It also shows that some countries (notably the United Kingdom, but also to a lesser extent Germany and the United States) have been able to weaken the link between cases and deaths (most likely through a comprehensive vaccine rollout but also possibly due to increasing levels of natural immunity).

KEY INPUTS TO DEVELOPMENT OF SCENARIOS

In modelling the COVID-19 pandemic, it has become evident that the key components of the so-called reproduction number or 'R-number' indicating viral propagation in countries' populations and determining the waves of COVID-19 infection are (1) the base infectiousness and transmissibility of the particular virus variant prevalent in a population; (2) the behaviour within the population in terms of exposure to the virus (inclusive of gatherings, compliance to mask wearing, social movement etc.) and (3) the degree of immunity already present in the population.

In this regard, the scenarios or theories outlined in this article are based on the following emerging evidence in respect of South Africa:

- It is known that new variants of the SARS-COV-2 virus have been responsible for the large majority of infections in the second and third waves experienced by South Africa, with the second wave comprised mostly of the 'beta' variant and the third wave was driven by the so-called 'delta' variant;
- The beta and delta variants were both found to be more transmissible than previous variants (with delta very significantly so) and, although the evidence on the rate of severe cases and deaths is mixed, also thought to be associated with higher rates of death or severe disease (research into it continues and these findings may change over time); and
- It has been reported in the media^{2,3}, although not through formal peer-reviewed studies, that recovery from COVID-19 infection caused by the beta variant grants broad immunity to several current strains of the virus; and
- The current research suggests that, with the exception of the AstraZeneca vaccine against the beta variant, all of the major vaccines currently in use (notably Pfizer and Johnson and Johnson which are being administered in South Africa) remain efficacious against the beta^{4,5} and delta^{6,7} variants.

TIMING OF A POTENTIAL FOURTH WAVE

Given the timing of the previous waves (first wave peaking July/August 2020, second wave around December 2020 into January 2021 and third wave July/August 2021), the most likely timing of a potential fourth wave would be over December 2021 and into January 2022. This appears to be the consensus of most modellers and infectious disease experts in South Africa, with the former chairman of the government ministerial advisory committee, Prof. Salim Abdool Karim even going as far as to predict 2 December 2021 as the start date⁸ for the fourth wave of infections.

SEVERITY OF A POTENTIAL FOURTH WAVE

The timing may be easier to predict, but the severity of the wave is much more complex to predict. Very few

analysts foresaw the delta variant and the associated severity of South Africa's third wave, although many were able to predict the timing. As such, the most reasonable approach is probably to continue to set out the possible scenarios in respect of the fourth wave. For the purposes of this article we have set out three potential options as follows (from lowest to highest potential impact):

- No fourth wave because of the large proportion of the population who have previously been infected;
- Large numbers of infections in the fourth wave, but significantly fewer severe cases due to the impact of vaccination; and
- A fourth wave similar in severity to the second and third waves with large numbers of infections, severe cases and deaths.

These scenarios are explored in more detail in the following subsections.

NO FOURTH WAVE

This is probably the least likely scenario, and would be predicated on a large immunity in the population due to the large numbers of previous infections. This immunity could in theory reduce the R number below 1 for a sustained period of time meaning no further infection waves. This would, however, require no new variants with higher transmissibility to emerge and overwhelm this immunity. This theory was posited for the third wave but failed to materialise, partially due to overestimates of the immunity level in the population post second wave and partially due to the increased transmissibility of the delta variant.

SUCCESSFUL VACCINATION ROLLOUT

As outlined in the previous section, although theoretically possible, it is unlikely that South Africa will avoid the fourth wave of infections. With current evidence suggesting that vaccination, while not entirely preventing transmission of the virus, is highly successful in preventing severe symptoms, if the country is successful in vaccinating the majority of the adult population, especially the elderly and other vulnerable groups, large numbers of hospitalisations and deaths could be avoided in the fourth wave.

In this scenario, South Africa would mirror the experience of many countries with large-scale vaccine rollouts, most notably the United Kingdom, with a significant wave of cases but only a muted wave of severe infections and deaths. Reaching it will, however require large numbers of people to come forward to be vaccinated and the logistics of the rollout to be enhanced to ensure vaccines

reach especially the rural and less technologically enabled population, as well as overcoming the vaccine hesitancy and outright anti-vaccine sentiment which still exists.

SIMILAR TO PREVIOUS WAVES

The third possible scenario is that the vaccine rollout doesn't reach as large a proportion of the population as it needs to (or a new variant is discovered and the vaccines provide insufficient protection against that new variant), meaning that the fourth wave proceeds in a very similar manner to the second and third waves i.e. large numbers of infections, severe levels of lockdown and many hospitalisations and deaths.

This would be the scenario the country is hoping to avoid through careful relaxation of the restrictions and acceleration of the vaccine rollout. However it still remains a possibility and cannot simply be disregarded.

CONCLUSION: THE MOST LIKELY SCENARIO

As outlined above, the consensus on the timing of a potential fourth wave is moving towards December 2021 into January 2022. However, the severity of that wave is significantly less certain. In terms of the three scenarios set out previously:

- The least likely given past experience of the coronavirus pandemic is that a fourth wave is avoided entirely;
- The partial vaccination rollout targeting the most vulnerable probably also makes the last scenario of a fourth wave similar to the third wave less likely; but
- Given the problems encountered on both the supply and demand side of the vaccine rollout, it wouldn't be fair to conclude that the middle scenario i.e. a full vaccine rollout before the fourth wave starts would be the most likely.

As such given current evidence the most likely scenario is probably a hybrid of the second and third scenarios outlined previously i.e. there is a significant wave of infections over December 2021 and January 2022, but the partial vaccine rollout, allied to previous immunity causes a more muted wave of hospitalizations and deaths in the fourth wave. This would be akin to the early pattern in the United States and probably a larger wave than has been experienced in the United Kingdom. 

² <https://www.timeslive.co.za/news/south-africa/2021-03-20-sa-covid-19-variant-produces-antibodies-that-provide-broad-protection/>

³ <https://www.iol.co.za/news/south-africa/gauteng/covid-19-variant-found-in-sa-offers-immunity-against-other-variants-2be15cfd-419a-46c2-a24d-cdd95de85d45>

⁴ <https://theconversation.com/covid-the-beta-variant-is-surging-in-mainland-europe-should-the-uk-be-worried-164815>

⁵ <https://www.advisory.com/daily-briefing/2021/07/26/beta-variant>

⁶ <https://www.healthline.com/health-news/heres-how-well-covid-19-vaccines-work-against-the-delta-variant#What-do-we-know-about-the-Delta-variant?>

⁷ <https://www.cdc.gov/coronavirus/2019-ncov/variants/delta-variant.html>

⁸ <https://www.bloomberg.com/news/articles/2021-08-17/s-africa-sees-covid-19-fourth-wave-starting-in-early-december>

TARGETING PULSE OXIMETER USE TO PREVENT SILENT HYPOXAEMIA

By Shirley Collie, Chief Health Analytics Actuary, Discovery Health

Silent hypoxaemia refers to low blood oxygen levels in patients who appear clinically well but which leads to rapid deterioration due to the body's tissues being starved of oxygen. The challenge is that by the time patients do experience symptoms there has been extensive, possibly irreparable damage to the lungs and other body systems. It became apparent early in the pandemic that early detection was critical to saving lives and a valuable tool for doing this is the pulse oximeter which is a relatively low-cost and easy to use device. The National Health Service in the UK purchased around 200 000 of these devices with the intention of giving these to patients identified as being at high risk for developing severe Covid-19 infection. Discovery Health similarly provided pulse oximeters to high risk patients and then conducted a retrospective study to assess the effectiveness of the intervention which has been published in the South African Medical Journal

IDENTIFYING HIGH RISK PATIENTS

Patients were categorised as high risk, if they had specific underlying clinical conditions such as diabetes mellitus,cardiovascular conditions (hypertension, ischaemic heart disease), chronic lung disease (asthma, chronic obstructive pulmonary di 95% or above Continue to track and record your oxygen saturation levels twice daily, during the two-week period. sease), immunocompromise (HIV, cancer, immunosuppressive treatments such as those for autoimmune diseases or post-transplant), chronic liver disease and pregnancy, or if they were classified as high risk from predictive models based on medical scheme administrative claims data.

A COVID-19 proxy model estimating the risk for admission was used to further categorize those at high risk for severe COVID-19. This model was defined as a composite of the risk for admission and the risk for admission with pneumonia. The following variables were considered when the models were fitted:

- Chronic conditions for which a member was registered
- Demographic factors such as age, sex and type of medical scheme plan purchased.
- Medications for which a member had claimed in the previous 12 months
- Procedures and consultations for which a member had claimed in the previous 12 months

Table 1. Pulse Oximeter Readings and Guidance

95% or above	Continue to track and record your oxygen saturation levels twice daily, during the two-week period.
90% to 94%	If your levels decrease to between 90% and 94% over two readings taken at least an hour apart, you must call your treating general practitioner for medical assistance
Below 90%	If your levels decrease to below 90% on any reading, or if you have difficulty breathing, get urgent medical care.

- The type of physician practice that member attended in the previous 12 months
- ICD information from claims in the previous 12 months

Both these models were built in python using the XGBoost algorithm. Graphs with the variable importance for the different models are provided (supplementary figure 1 and 2). The model results were validated by testing the sensitivity and specificity against unseen data, which comprised 30% of patient records. The precision recall area-under-the-curve (PR-AUC) of the validated test results was 47.8%, while for the training dataset was 51.9%. Both these models were trained on the period 1 June 2018 – 31 May 2019. Members who tested positive for COVID-19 and had a higher than 10% likelihood of admission risk were flagged as eligible to receive an oximeter.

After 17 September 2020, a model was built on COVID-19 admissions to date. This model had improved precision recall metrics on training data (PR-AUC of 58.0%) and was validated on 30% of unseen data (PR-AUC of 51.5%). Patients were classified as high risk from this model, if they had a minimum of 44% likelihood of admission risk.

The patients identified as high risk in the period June 2020- November 2020 were contacted by a wellness specialist who guided them on how to monitor their blood oxygen (twice daily) and what to do in the event of adverse results.

Continuous variables were described using means (standard deviation) and, where appropriate medians (interquartile range). Categorical variables were described as a number (percentage). For continuous variables, statistical comparisons were performed with an independent t-test for normally distributed data, and a Wilcoxon sign rank test for non-normally distributed data. The follow-up period for the analysis was 60 days post RT-PCR collection date or until censoring.

The highest rate of daily deaths and admissions in the high-risk population occurred on the day of PCR collection, and steadily declined each day post the date of PCR collection. The turn-around-time of test results amongst patients and the time taken to dispatch of the pulse oximeter was not constant (supplementary figure 3). In order to avoid bias, mortality outcomes for the intervention group post-dispatch of the pulse oximeter were compared to the control group per day, relative to the PCR collection date, using Cox multivariate analysis. The following features were included as factors in the Cox multivariate models: age band, number of chronic conditions, hypertension, diabetes mellitus, hypercholesterolaemia, hypertension, human immunodeficiency virus (HIV) positivity, asthma, and, an "intervened indicator" for patients who accepted a pulse oximeter. Observation times were based on days since the PCR collection date. The hazard ratio of each feature was used to assess the relative impact on mortality risk, as well as the associated p-values. Statistical analysis was performed using Excel 2016 and R (version 3.6.3) using the Grammar of Data Manipulation package (dplyr) and, survival libraries.

Table 2: Summary of impact of pulse oximeter intervention on clinical outcomes

	Rate per patient	HR for impact of the intervention on the study population	Lower 95% CI	Upper 95% CI	p-value
Admission ^a	10.098%	1.03	0.92	1.17	0.59 ^d
Length of stay ^a	7.50 days	1.078	1.05	1.093	<0.0001 ^e
ICU ^b	1.650%	1.02	0.80	1.31	0.86 ^d
Mechanical ventilation or ECMO ^c	0.904%	0.97	0.69	1.36	0.86 ^d
Mortality	1.419%	0.52	0.38	0.70	<0.0001 ^d

- a) Excludes 330 patients in the study group who had an admission prior to receiving a pulse oximeter, resulting in 7783 remaining patients in study group
- b) Excludes 30 patients in the study group who had an ICU admission prior to receiving a pulse oximeter, resulting in 8083 remaining patients in study group
- c) Excludes 23 patients in the study group who had mechanical ventilation or ECMO prior to receiving a pulse oximeter, resulting in 8090 remaining patients in study group
- d) p-value obtained from intervention hazard ratio from Cox multivariable models for each of the analysed outcomes
- e) t-test based on mean difference in average length of stay between the study and control populations

Table 3: Total number of patients with admissions and a CRP on admission date.

	Study population	Control population	Total	p-value
Admissions	321 (8%)	3 642 (92%)	3 963	
CRP test results available on day of admission	238 (10%)	2 115 (90%)	2 353	
Median CRP test result (interquartile range)	56 mg/l (21.2-111.1)	70 mg/l (20.5-141.7)	68.3 (20.5-138.1)	0.03*

OUTCOME EVALUATION

The outcome evaluation was the determination of whether the 60-day mortality rate for the intervention group was better than that of the control group. Furthermore, admission outcomes, including level of acuity, length of stay in hospital, and C-reactive protein levels on admission date were compared between the two groups.

Initially 53 038 patients were evaluated for inclusion into the study, 10 862 in the intervention group and 42 176 in the control group. After applying the exclusion criteria, 8 113 patients remained in the study population, and 30 532 in the control population, resulting in 38 645 patients included in the final analysis, of which 586 withdrew from the scheme prior to elapse of the follow-up period.

Compared to the control group, the intervention group was significantly older, had a higher proportion of males (41%), and the patients were more likely to have hypertension (34%), hypercholesterolaemia (21%), diabetes mellitus (15%), HIV (8%) and asthma (12%) (Table 2). The proportion of patients presenting with the top five registered chronic conditions was also more prevalent in the intervention group (56.3% vs. 42.4% for controls).

The overall 60-day mortality risk of the population was 1.35% (1.24% - 1.46%), representing 544 deaths. Patients over the age of 80 years had the highest 60-day mortality risk of 14.59% (12.33% - 16.78%). Of all chronic conditions evaluated, patients with diabetes had the highest 60-day

mortality risk, 4.61% (4.00% -5.22%). The 60-day mortality rate for the intervened population was 0.68% (0.49%-0.88%) compared to 1.44% (1.32 - 1.57) for the control group.

Adjusting for all co-variates in the 30-day Cox mortality model, the following was noted with regard to relative risk within the evaluated high-risk population (Table 4):

- The study population had a relative risk (RR) of mortality of 0.52
- Increased age had a higher risk of mortality e.g. lives aged 50-59 years had a RR of 1.95 whereas those aged 80 years or older had a RR of 4.48
- Males had a RR of 1.96
- Diabetic members had a RR of 2.27
- Members with hypercholesterolaemia had a RR of 0.75
- Patients with three or more chronic conditions had a RR of 1.76
- Patients with hypertension, asthma, or HIV, and patients with 1 and 2 chronic conditions, were not associated with significantly increased risk of mortality, given the other variables considered by the model

A sensitivity analysis was performed to explore whether the relative risk for the study population would be different in the provinces where COVID-19 was most prevalent, namely Gauteng and Western Cape. This represented 79% of the data. It was found that the study population had a RR of 0.5. The mortality findings remained consistent with the findings of the entire population, apart from hypercholesterolaemia which was not associated with an increased risk of mortality.

RISK FACTORS FOR MORTALITY

Risk factors were multiplicative relative to the base, where the base consisted of non-intervened lives, female lives and those aged less than 40 with no chronic conditions (Table 4):

- Diabetic males aged 50-59 had a 31.3 times higher mortality risk (2.27 x1.96 x 7.03)
- Males aged 70-79 had 63.5 times higher mortality (1.96 x 32.38) whereas female aged 70-79 had a 32.4 times higher mortality risk

The impact of the pulse oximeter intervention on clinical outcomes is shown in Table 5.

Three hundred and twenty-one patients in the study population were admitted. The impact of the intervention resulted in a non-significant 3% higher likelihood of admission relative to the controls. (p= 0.59). The mean length of stay for the intervention group was 8.03 days compared to 7.45 days for the controls (p<0.0001). d, but if the mortality was equivalent to the controls, 95 (95% CI 70.5,128.1; p value<0.0001) deaths would have been expected i.e. 46 fewer deaths in the pulse oximeter group relative to the controls (95% CI 21.5, 79.1; p-value<0.0001), (Table 3). The aim of providing patients at high risk of severe COVID-19 infection with pulse oximeters was to improve clinical outcomes by earlier identification of silent hypoxaemia or a deterioration in oxygen saturation and in so doing decreasing the acuity of admissions, the requirement for intensive care and mechanical ventilation and the number of deaths. The data adjusted for risk, showed a statistically significant improvement in 60-day mortality (0.52 hazard ratio, p<0.0001) for the intervention group despite the fact that this group consisted of older patients,with a higher prevalence of the top five comorbid conditions, who should have been at higher risk for worse outcomes.

Patients that accepted a pulse oximeter may have been more conscientious and aware of symptoms and may potentially have been more likely to seek care timeously, regardless of having receipt of a pulse oximeter. The effect is however, expected to be small, as most members that were contacted accepted the device (83% telephonic acceptance rate). In either event, the impact of early intervention with lives identified as high risk led to reduced mortality experience. This is a good example of rapid analytics saving lives. 

Reference: NEMATSWERANI, N et al. The impact of routine pulse oximetry use on outcomes in COVID-19-infected patients at increased risk of severe disease: A retrospective cohort analysis. South African Medical Journal, [S.l.], sep. 2021. ISSN 2078-5135. Available at: <<http://www.samj.org.za/index.php/samj/article/view/13397>>

A REFLECTION ON THE PANDEMIC EXPERIENCE AND ANALYTICS TO DATE

By Roseanne Harris, Health Policy Actuary, Discovery Health



COVID-19 has wreaked havoc in many aspects of South African society. There has been a tragic loss of life and great societal distress from illness. There has also been a massive economic cost due to the impact of the pandemic on economic activity as well as the impact of lockdown measures necessitated by the pandemic, and there has been massive disruption to the delivery of healthcare.

Discovery Health (DH) administers close to 4m medical scheme lives across 20 medical schemes. This article provides an insight into the experience of this subset of the South African population and some comparisons to national experience

CURRENT STATUS

As we emerge from the 3rd wave, reported new daily infections in South Africa have declined from a peak of 18 900 with very different patterns

observed across the provinces. Reported active infections are also now lower than the peak across all provinces. The reported case fatality rate has also varied significantly across the provinces ranging from as low as 1.3% in Mpumalanga to 5.1% in the Eastern Cape and averaging around 3% nationally.

There have been 419 762 reported COVID-19 cases in the DH population to 28 September 2021 and 14 059 deaths. This is a case fatality rate of 3.4% which is higher than the national level based on reported cases, and this difference is likely to have been impacted by higher levels of under-reporting in the uncovered population. Over the period since March 2021, 12% of DH lives have reported a Covid-19 infection. In just over 14% of these cases, a hospital admission was required. These figures compare to 2.9m reported cases nationally and 87 001 deaths. This translates to around 5% of the national population reporting a COVID-19 infection and suggests significant under-reporting of infections and deaths given the South African Medical Research Council (SAMRC) analysis of excess deaths both nationally and across provinces.

As per the SAMRC report published for the period ending 11 September 2021, the estimated number of excess natural deaths of persons 1+ years is 257,543. Assuming that 90% of excess natural deaths are related to COVID-19 (based on Moultrie et al. Correlation of excess natural deaths with other measures of the Covid-19 Pandemic in South Africa⁹), there have been 231 789 estimated COVID-19 deaths which implies an under-reporting factor of 2.7 against reported deaths of 84 751 nationally for the period. This puts the South African experience at around 3 800 deaths per million, amongst the highest globally.

GETTING THE VACCINATION PROGRAMME GOING

Vaccination is an important public health intervention that has been associated with a decreased incidence of numerous infectious diseases and associated deaths. It is often considered as the most cost-effective public health intervention after clean water.

The Global Alliance for Vaccines and Immunizations (GAVI) considers vaccination as the most cost-effective way to save lives, improve health and ensure long-term prosperity. Rapid implementation of a vaccination programme is aimed towards:

- Preventing as much severe COVID-19 disease and death as we can as quickly as possible
- Building population immunity by vaccinating as many people as possible as soon as possible
- Starting with groups with highest risk for severe illness and death and work downwards towards lowest risk
- Ensuring community and workplace survival
- Preventing lockdowns and other social and economic disruptions
- Ensuring that society, education and the economy can open up and resume full capacity

The South African vaccination programme suffered several initial setbacks. This included the disappointing results from the South African arm of the Astra Zeneca vaccine, leading to the South African government halting the vaccine rollout of the Astra Zeneca vaccine, delays and production challenges associated with the Johnson and Johnson (J&J) vaccine and delays in the procurement of Pfizer BioNtech vaccines.

The Sisonke trial covered 487 466 healthcare workers with the J&J vaccines from March to May 2021. Phase 2 (covering those aged 60 and older) along with phase 1B (health workers) commenced on 17 May 2021 included both J&J and Pfizer BioNtech vaccines.

PRIORITIZATION

The supply constraints necessitated a prioritization process that aimed to reflect the risk of various sub-populations to severe illness and death associated with COVID-19. As part of this process, DH provided analysis covering the experience of 179 683 individuals with infections from March 2020 to 7 February 2021. This analysis indicated that:

- Age is the dominant factor for admission risk with the relative risk increasing by approximately 3% per year of age.
- Relative risk of above 60 age group is over 6.

⁹ <https://www.samrc.ac.za/sites/default/files/files/2021-03-03/CorrelationExcessDeaths.pdf>

- Co-morbidities are also significant for stratification within age groups and in the younger age bands. In particular there is elevated risk associated with:
- Multiple chronic conditions (3+): 1.78
- Diabetes: 1.57
- HIV: 1.43

Key conclusions were

- More than 3 chronic conditions has a higher relative risk of a COVID-19 admission than an average person over 60 with no chronic conditions
- Diabetes contributes significantly to relative risk of a COVID-19 admission
- Chronic condition groups have a higher relative risk of a COVID-19 admission with Diabetes than without
- These results showed consistency with an analysis of COVID-19 deaths in the Western Cape which found that among 3 460 932 patients (16% HIV positive), 22 308 were diagnosed with COVID-19, of whom 625 died. COVID-19 death was associated with male sex, increasing age, diabetes, hypertension and chronic kidney disease. The age adjusted relative risk levels for co-morbidities relative to age were similar

Analysis of the NICD data also supported an age based roll out. The experience to April 2021 indicated:

- The over 60 population comprises 9% of the total population but accounts for 60% of deaths and 36% of admissions.
- Adding the 50-60 population covers 17% of the total population but accounts for 81% of deaths and 58% of admissions.
- And adding the 40-50 population covers 29% of the total population but accounts for 92% of deaths and 75% of admissions.

The significantly higher risk associated with age as well as the challenges of assessing chronicity, particularly for public sector patients, led to the vaccination programme being structured on an age basis following the roll out to healthcare workers and was augmented by occupational (for example, teachers) and worksite specific programmes.

VACCINE PROGRESS

Once the programme finally got going in earnest in May, there was good progress - comparing well with the first two months of roll out in many wealthier nations that did not have the challenges with securing vaccine stock that we have had. The SA vaccination rate per 100 000 people in the first 2 months was 7.9, which is lower than the rapid roll out in the UK and USA but compares favourably with countries like Switzerland, Sweden, Spain, Belgium, Germany and Italy and significantly exceeds countries like Australia (5.6), New Zealand (4.3), Canada (3.5) and Japan (2.1).

The capacity to deliver vaccines has been increasing steadily. Currently there is active capacity to administer over 400 000 vaccine doses per day. Concerningly, this is not all being taken up with daily doses in the 150 000 to 200 000 range. 17 176 603 vaccine doses have been administered up to 28 September 2021. This is made up of 3 816 827 J&J doses and 13 359 776 Pfizer doses. Over 12m people (32% of the adult population) have received at least one dose and 8.6m people are fully vaccinated.

More than 2.1 million vaccines have been administered to DH lives and around 56% of adult lives have received a vaccine and are partially or fully vaccinated. Among those over 60 years, close to 78% have received a vaccine. This has had a significant impact on claims experience. Beneficiaries that have not been fully vaccinated account for 92% of Covid-19 admissions and 94% of COVID-19 deaths in the two weeks to 26 September. This mirrors the experience reported by others including the Western Cape Department of Health and Mediclinic.

VACCINE EFFICACY

DH's initial analysis of individuals who have passed 21 days or more after receiving their first Pfizer-BioNtech dose to a comparable cohort of unvaccinated members found:

- A 34% lower incidence of new COVID-19 infections; and
- A 47% lower rate of admission to hospital to treat COVID-19 related sequelae (medical complications).

Positive data has also emerged from the South African Medical Research Council's study of the Sisonke trial, in which just under 480 000 local healthcare workers received the single-dose J&J vaccine. Analysis shows that in vaccinated healthcare workers, there is up to 71% protection against severe illness and hospitalization and up to 95% protection against death. Also, 96% of breakthrough infections (infections post vaccination) were mild, 3% moderate and less than 0.05% severe or critical.

Importantly, the study has found that the J&J vaccine has a good safety profile while also offering good immediate and sustained immune responses against the Delta variant (with immune protection lasting up to eight months).

This adds to the accumulating evidence that the J&J and Pfizer-BioNtech vaccines are both effective against the variants of concern and further detailed supporting analysis will be published shortly.

A previous COVID-19 infection does not necessarily imply enduring immunity against future Covid-19 infection. Re-infections that are detected more than 90 days after an initial COVID-19 infection, are possible. Using an approach of matching individuals that had repeat positive tests to their "clinical twin" that initially tested negative for COVID-19 and using a Kaplan Meier model, DH's data show that, overall, the relative risk of a repeat positive infection against an index infection for a population that initially tested negative is estimated at 19.6%, the relative risk of a COVID-related admission is estimated at 16.3% and the relative risk of death is estimated at 36.5%.

COST BENEFIT ANALYSIS

The COVID-19 pandemic is estimated to have generated R11.10 billion in additional healthcare expenditure since March 2020, for schemes under DH administration. This represents 6% of risk expenditure in 2020 and 17% of risk expenditure for year to date July 2021. COVID-related admissions and PCR testing constitute the bulk of these costs (73% and 16% respectively). The average cost per Covid-19 admission has been in excess of R125 000.

A PREVIOUS COVID-19 INFECTION DOES NOT NECESSARILY IMPLY ENDURING IMMUNITY AGAINST FUTURE COVID-19 INFECTION. RE-INFECTIONS THAT ARE DETECTED MORE THAN 90 DAYS AFTER AN INITIAL COVID-19 INFECTION, ARE POSSIBLE.

DH conducted a cost-benefit analysis that compared the actual costs of treating those infected with COVID-19 against their expected costs had the vaccine been rolled out in February 2020.

A retrospective analysis was chosen because of the uncertainty of projecting COVID-19 experience into the future. This analysis was performed by analyzing the cohort of detected COVID-19 infections across DH schemes from March 2020 until 28 February 2021. It is assumed that all COVID-19 infections would be closed due to recovery/death.

- Demographic data for all lives on DH administered schemes 18 years and older including
 - Age
 - Chronic status
- Costs related to COVID-19 infected and detected lives
- Estimates on vaccine efficacy from available research set conservatively at:

	Pfizer	J&J
Out of Hospital Cost Reduction Post Vaccine	73.5%	63.0%
In Hospital Cost Reduction Post Vaccine	97.4%	81.0%

- Vaccine cost estimates on NDoH pricing
- Expected vaccine uptake (70% to 80% across member categories)

The population was divided into three categories based on population analysis including excess deaths and case fatality rates:

- Infected and detected (7%)
- Infected but undetected (these are asymptomatic cases and can include mild cases) – this is estimated with reference to the population excess deaths analysis and the infection fatality rate for South Africa as published by the SAMRC (37%)
- Uninfected balance of the population (56%)

Based on vaccine efficacy data, we assumed that those scheme members who are vaccinated against COVID-19 will experience a reduction in infections

and serious illness in line with published evidence. Further, given that the number of scheme members who contract COVID-19 is known for this historic period, we calculated the savings in respect of those scheme members who are vaccinated against COVID-19 on the basis that they should experience up to a 94% drop in the risk of experiencing severe disease requiring hospitalisation, as well as a close to 70% reduction in out-of-hospital costs.

These improvements in a vaccinated scheme population are expected to yield net cost savings after allowing for the cost of vaccines for schemes administered by Discovery Health of around R2 billion (depending on the ultimate cost per vaccine dose administered). All in all, savings far outweigh the costs of treating COVID-19 in the member base, let alone the extensive societal and economic benefits associated with the vaccine programme.

The results are shown for various combinations of the J&J and Pfizer vaccines with associated risk reductions.

Table: Medical scheme benefits at current prices (DH schemes)

	Pfizer/J&J 50-50	Pfizer/J&J 60-40	Pfizer/J&J 80-20
OH Cost Reduction Post Vaccine	68.8%	69.7%	71.6%
IH Cost Reduction Post Vaccine	89.6%	91.1%	94.3%
Total Average Vaccine Cost Per Life	R 634	R 681	R 775
Pre Vaccine			
COVID-19 costs (Rbn)	R 4.62	R 4.62	R 4.62
With Vaccine			
COVID-19 costs (Rbn)	R 1.38	R 1.32	R 1.21
Vaccine Costs (Rbn)	R 1.19	R 1.28	R 1.45
Total Cost With Vaccine	R 2.57	R 2.60	R 2.66
Net Savings (Rbn)	R 2.05	R 2.02	R 1.96
% Savings of Costs	44.35%	43.72%	42.40%

An article published by the Economist on 9 June 2021 (as part of the publication’s G7 Summit coverage) states that return on investment to be gained as a result of a successful COVID-19 vaccine rollout over the next four years comes in at a massive 17 900%. This represents the largest ever potential return from a public health intervention ever.

The International Monetary Fund estimates put the cost of vaccinating 70% of the planet’s population by April 2022 at \$ 50 billion. The Economist’s analysis argues that the outlay required to achieve this would be very much affordable, at 0.13% of the G7 nations’ (a group of the world’s seven largest economies) collective GDP. All in all, the resultant economic benefit would be increased global output in the region of a staggering \$ 9 trillion.

VACCINE HESITANCY

There are good indications that the vast majority of South Africans are supportive of the vaccine programme and recognize the importance of getting vaccinated to protect their communities and our economy. The National Income Dynamics Survey (NIDS) published in July 2021 indicated that 71% of South African adults say they would get vaccinated if a COVID-19 vaccine was available. Among the 29% of respondents who were vaccine hesitant, the three leading reasons for their hesitancy were that they were worried about the side effects (31%), did not believe it was effective (21%) or did not trust vaccines in general (18%). This is the highest estimate of vaccine intention for adults in South Africa to date.

Other recent surveys have found similar levels of vaccine intention. The NIDS survey found that those most at risk of COVID-19 were more willing than the general population to accept a vaccine. They also found no evidence of a strong and monotonic relationship between any measure of socioeconomic status and vaccine hesitancy but did find evidence of a pathway via education: respondents with only primary schooling or less are more likely to be vaccine hesitant. This highlights the risk of vulnerable populations not getting accessible information and the need for clear education, mobilizing social and community channels to ensure everyone gets protected.



EPIDEMIC VS PANDEMIC VS ENDEMIC

An epidemic refers to the uncontrolled spread of a disease that affects a large number of people and a pandemic is when this spreads across continents. A disease becomes endemic when there is an established presence in a particular region or population (for example), but is not necessarily spreading uncontrollably. Of course, eradication would be the preferred outcome of any vaccination intervention as has largely been achieved with smallpox.

Since we are still likely to see the emergence of variants and vaccine protection is high but not absolute, COVID-19 becoming endemic is the likely outcome. But in the context of the high levels of protection from severe illness and death, the prospects of an overrun health system and the need for lockdown requirements dwindle as the vaccine roll-out progresses. ⚠️

LITERATURE REVIEW

on Covid-19 Vaccines, as a contribution to the debate on Vaccine policy in South Africa.

By Barry Childs, Dr Gareth Kantor

Vaccine hesitancy has been a prominent feature of the Covid-19 pandemic as vaccine programmes are being rolled out around the world. In the South African vaccine programme, this has resulted in demand for vaccines dropping below policy target levels.

At the time of writing, at least one vaccine (Pfizer) has matured from emergency to full FDA approval, and age groups as young as 5-11 are being considered for eligibility, while only a small fraction of adults in Africa and other Low and Middle Income Country regions are vaccinated.

Some concerns that have been expressed include vaccine safety, lack of long-term studies, medical treatment freedom of choice

and other elements giving rise to hesitancy or complete rejection of vaccines. The literature and emerging data on Covid-19 vaccines and immunity is already vast and continues to grow. This review considers a sample of papers to present findings pertinent to current debates.

Science.org contains a useful article describing¹⁵ various approaches to testing vaccine efficacy which the reader might find valuable for background reading.

An accessible summary of the evidence as at the time of writing is available on the CDC website: <https://www.cdc.gov/coronavirus/2019-ncov/science/science-briefs/fully-vaccinated-people.html> which includes links

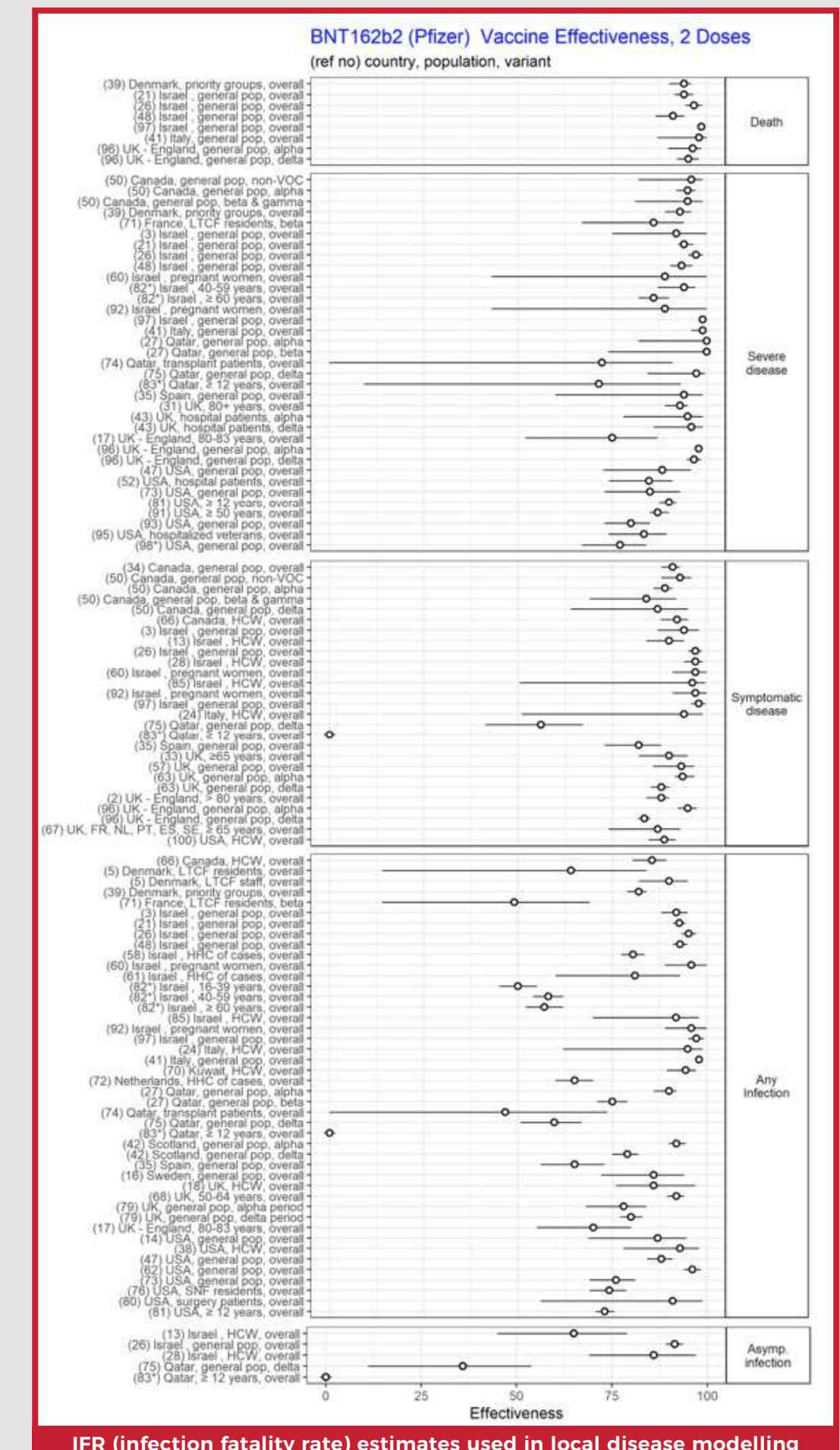
to the original studies and papers. The CDC of the African Union also collates resources at <https://africacdc.org/covid-19/covid-19-resources/>.

The term vaccine efficacy and vaccine effectiveness warrant explanation to avoid misinterpretation¹⁶. A study showing vaccine efficacy of 80% against severe disease does not mean that 20% of those vaccinated had severe disease. Rather, it means that the vaccinee cohort had an 80% lower chance of developing severe disease compared to the placebo cohort in the study. Vaccine effectiveness, on the other hand, is a reflection of how well the vaccines work to protect communities in the real world.

EFFECT ON COVID-19 DISEASE AND MORTALITY

In brief, all vaccines approved for use (emergency or full approval) in the USA, which includes the Pfizer and Johnson & Johnson vaccines being used in South Africa, show effectiveness in prevention of infection caused by SARS-COV-2 and of mild or severe Covid-19 disease, or death. These effects are established from one- or two-weeks post full vaccination, depending on the study. Prevention of severe disease, hospitalisation, and death is stronger than effectiveness in preventing mild or asymptomatic infection. Protection against variants (beta, delta) is less than against the base Wuhan (alpha) virus. Data from South Africa's Sisonke Trial¹⁷ which administered the J&J vaccine to healthcare workers showed strong benefits for vaccinated vs unvaccinated healthcare workers for mortality and hospitalisation. The beta variant was dominant at the time. Deaths from so called breakthrough infections were recorded at 0.05% which is 10 times lower than the more conservative Studies of vaccine efficacy continue to accumulate.

A compilation is summarised at view-hub.org/.¹⁸



¹⁵ <https://www.science.org/doi/full/10.1126/science.abe5938>

¹⁶ <https://www.who.int/news-room/feature-stories/detail/vaccine-efficacy-effectiveness-and-protection>

¹⁷ <https://sacoronavirus.co.za/wp-content/uploads/2021/08/Sisonke-Provisional-Results-6-August-2021GG2.pdf>

¹⁸ https://view-hub.org/sites/default/files/2021-09/COVID19%20VE%20Studies_Forest%20Plots_3.pdf

EFFECT ON TRANSMISSION

Vaccine effect on transmission is another policy consideration. Some studies show that viral loads and viral shedding are equivalent among vaccinated break through infections and novel infections¹⁹. Other studies show that transmission is dampened among the vaccinated. A study from the UK²⁰ showed a 0.7 [95% confidence interval [CI], 0.63 to 0.78] hazard ratio for household members becoming infected 14 days after one dose of vaccine and a hazard ratio of 0.46 [95% CI, 0.30 to 0.70] 7 days after the second dose (Pfizer). Another prospective household transmission study²¹ showed hazard ratios of 0.55 and 0.57 for household transmission after Astra Zeneca and Pfizer vaccinations respectively. The nominal reductions in secondary infection were 10.1% to 5.7% and 10.1% to 6.2% respectively.

A study in Belgium²² showed effects of similar magnitude while conducting extensive ongoing testing of the cohort under study.

Efficacy against any infection across a number of studies²³ at <https://view-hub.org> shows a 45 - 100% range of effect in terms of reduction of infection transmission depending on study design, population group and other factors.

WANING IMMUNITY

The immune system is highly complex, multifaceted and may manifest differently in different people depending on a range of factors driving incompletely understood variations in susceptibility and severity of disease. In that light, it is difficult to know how long immunity (vaccine acquired or natural immunity) lasts or even how to measure it exactly when clinical outcomes are not yet available. After infection or immunisation, antibody counts predictably wane over time, but this is not in itself an indication of waning immunity. The body retains its ability to recognise viral threat and mount a response when challenged (including the generation of antibodies by B-lymphocytes and of various T-lymphocytes). Studies have shown persistence of antibodies more than 5-7 months after infection. Articles^{24 25} in the BMJ contains a useful summary of the key points of long- term immunity.

VACCINATION VERSUS NATURAL IMMUNITY

A key point in the policy debates on matters of mandates and coercion is the effect of vaccines compared to natural immunity. 'Natural immunity' refers not to cross immunity from previous exposure to other coronaviruses, but to infection with the novel SARS-COV-2 virus and recovery from

Covid-19 (including symptomatic and asymptomatic cases). The relevance of this question in South Africa arises from the widely held view that a very large portion of the population has now been infected. There are generally two schools of thought. One is that the official Covid-19 death statistics (circa 85,000 deaths) reflect reality and that the infection fatality rate (IFR) for Covid-19 is around 0.2%. This extrapolates to an estimate of 42 million infected or 72% of the population. The alternate view is that a high proportion of the SAMRC excess natural mortality figure (say 90% of the circa 260,000 excess natural deaths) are Covid-19 deaths and that the IFR for South Africa is closer to 0.5% (owing to our relatively high burden of disease). This results in an estimate of 45 million infected or 76% of the population.

Some studies show that naturally acquired immunity for recovered individuals provides stronger protection against Covid-19 reinfection and transmission showing higher breakthrough infections for vaccinees compared to those who recovered from a previous infection²⁶. Natural immune responses can vary widely²⁷, whereas vaccine immune responses are more consistent. Given the unpredictability of individual immune responses²⁸, even among lower risk groups (for example younger ages), most

experts caution against seeking infection to obtain immunity.

Antibody tests do not reliably establish prior infection (false negatives) as antibody levels wane over time. Neutralising antibody assays which are better indicators of protection are expensive and not widely accessible. It is, therefore, not easy at the population scale to establish who has protective immunity derived from prior infection with SARS-COV-2. A program of frequent and on demand testing that could be used to reduce the risk of social gatherings is feasible but costly.

The rationale for requiring universal vaccination is driven by practicality, overall cost, predictable population benefit, protection of the health care system and the expected speedier return of social and economic activity. Given the very small risks associated with approved vaccinations, and the accumulated evidence of effectiveness regarding immunity and protection from severe illness, vaccine programmes are widely adopted globally as a key part of Covid-19 policy.

HYBRID IMMUNITY²⁹

Given vaccination programmes are proceeding without consideration of previous infection, the question of hybrid immunity arises. The evidence is that a single dose of a two-dose vaccine such as Pfizer provides strongly enhanced immunity from Covid-19. Some studies show that



vaccine adverse effects are higher for those previously infected³⁰, which seems related to elevated levels of antibodies post vaccination. A case could be made for limiting those with confirmed prior infection to a single dose of vaccine, which would conserve vaccine supply.

VACCINE SAFETY

Extensive safety testing is conducted before medicines and vaccines³¹ are licensed for use. Because of the rapidity with which Covid-19 vaccines were developed, some have questioned whether enough testing has been done. While expedited, Covid-19 vaccine development has been built on decades of prior research and experience with vaccine development and use. Concerns over the risk - benefit trade-off for younger ages have also been raised. Among young males, the risk of vaccine-induced myocarditis has received a lot of attention.

One large-scale study³² shows the relative risks and benefits by age group with compelling evidence that benefits outweigh risks even for younger age groups. "Per million mRNA COVID-19 vaccines administered to males aged 12-29 years, 11,000 COVID-19 cases, 560 hospitalizations, 138 ICU admissions, and six deaths due to COVID-19 could be prevented, compared with 39-47 expected myocarditis cases after COVID-19 vaccination."

Vaccine safety should also be weighed against risks arising from SARS-COV2 infection as demonstrated in this large-scale study³³ which showed elevated risks of myocarditis, lymphadenopathy, and appendicitis from vaccination. However, the elevated risks of myocarditis and other adverse events arising from infection with SARS-COV2 far exceeded risks than those arising from the vaccine. 

¹⁹ <https://www.medrxiv.org/content/10.1101/2021.07.31.21261387v4.full.pdf>

²⁰ <https://www.nejm.org/doi/full/10.1056/NEJMc2106757>

²¹ <https://www.thelancet.com/action/showPdf?pii=S1473-3099%2821%2900460-6>

²² <https://www.sciencedirect.com/science/article/pii/S0264410X21011087>

²³ https://view-hub.org/sites/default/files/2021-09/COVID19%20VE%20Studies_Forest%20Plots_3.pdf

²⁴ <https://www.bmj.com/content/bmj/373/bmj.n1605.full.pdf>

²⁵ <https://www.bmj.com/content/374/bmj.n2320>

²⁶ For example, <https://www.medrxiv.org/content/10.1101/2021.08.24.21262415v1.full.pdf>

²⁷ <https://www.bmj.com/content/bmj/373/bmj.n1605.full.pdf>

²⁸ <https://www.bmj.com/content/374/bmj.n2101>

²⁹ <https://www.science.org/doi/full/10.1126/science.abj2258>

³⁰ <https://www.medrxiv.org/content/10.1101/2021.07.31.21261387v4.full.pdf>

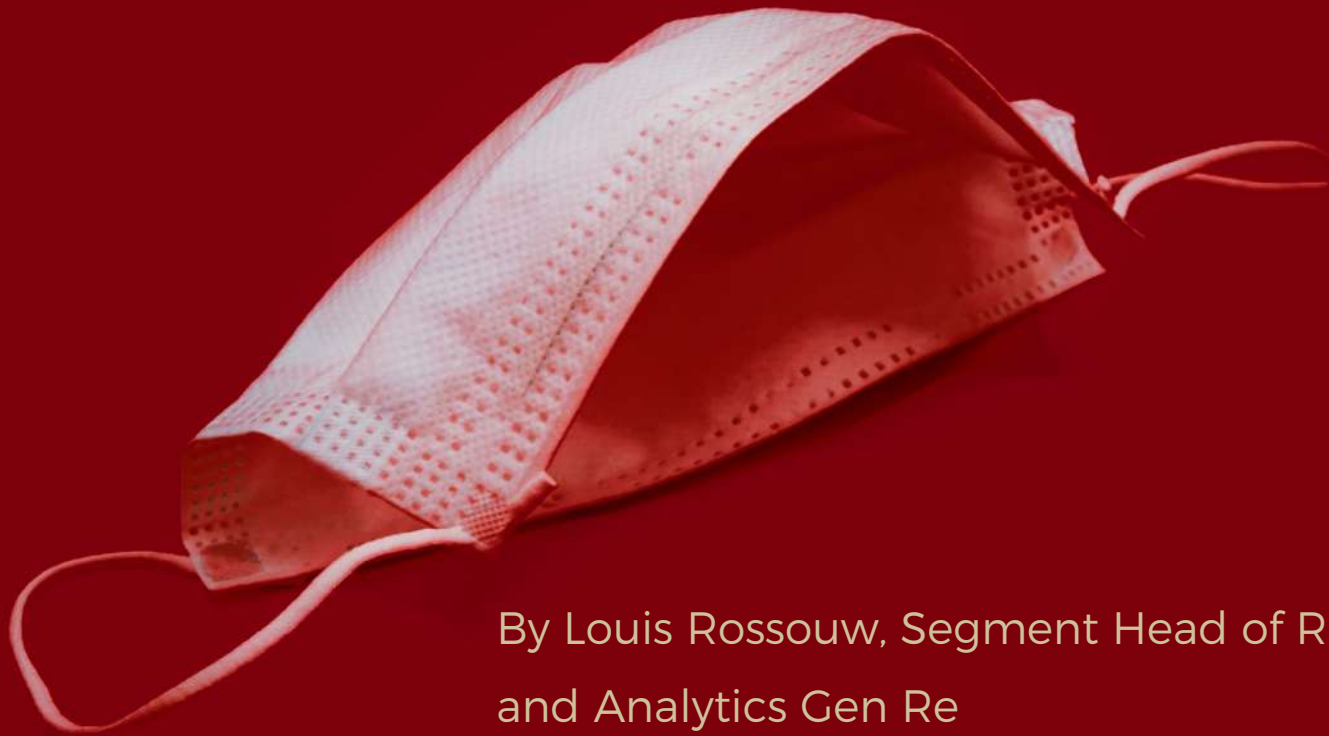
³¹ For example <https://www.nejm.org/doi/full/10.1056/nejmoa2034577> with negligible adverse events arising

³² <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8312754/>

³³ <https://www.nejm.org/doi/full/10.1056/nejmoa2110475>

LIFE INSURANCE IN A PANDEMIC

WHAT ARE THE IMPLICATIONS?

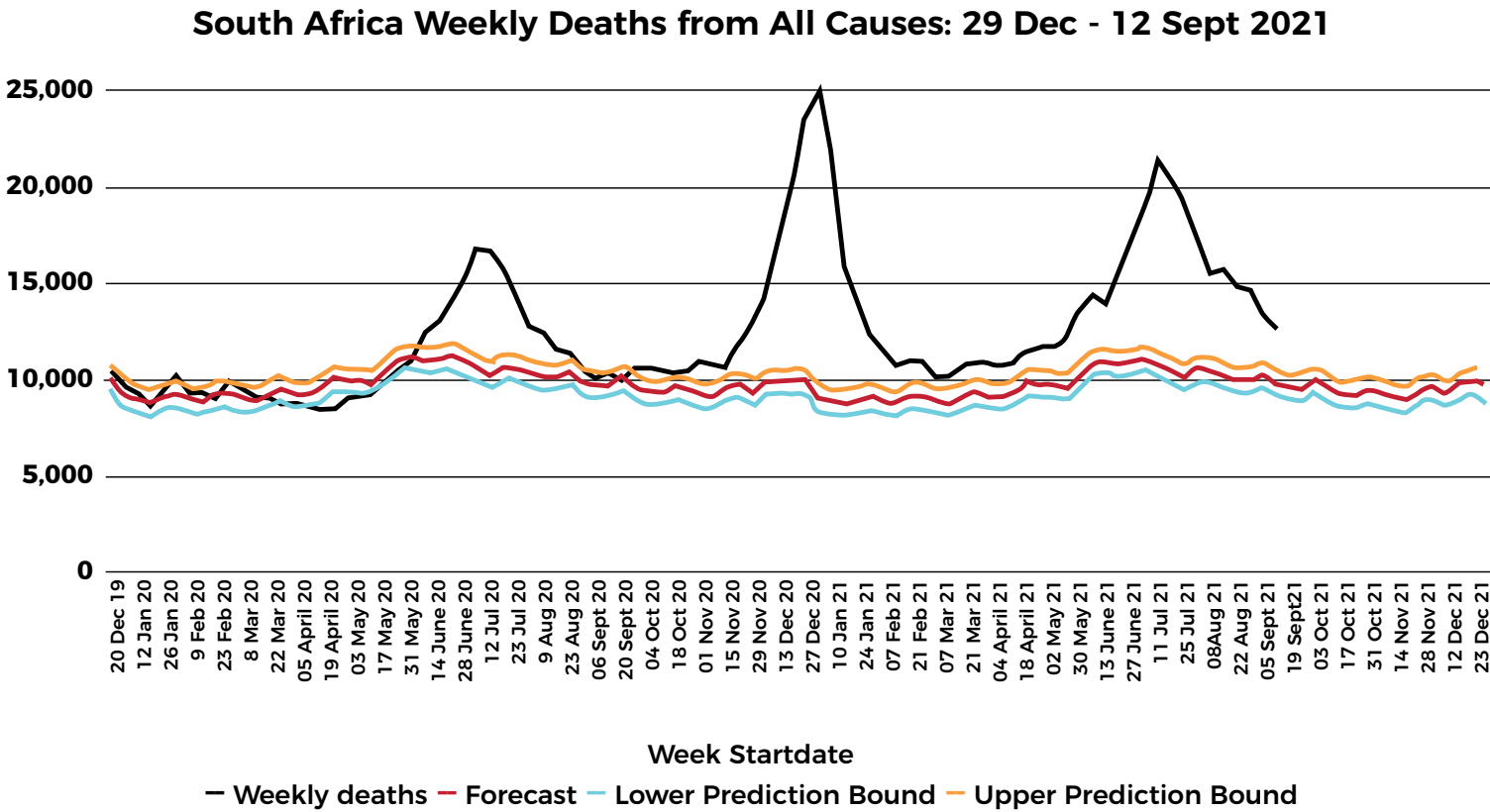


By Louis Rossouw, Segment Head of Research and Analytics Gen Re



South Africa has seen **one of the highest burdens** of excess deaths during the COVID-19 pandemic in the world. It has experienced an estimated in excess of 260 000 excess natural deaths since the start of the epidemic up to 18 September 2021 (as **estimated by the MRC and UCT researchers**). This measures the excess registered deaths due to natural causes since May 2020 compared to the expected natural deaths (based on projections from past death patterns).

The graph below (from the linked report) shows the total deaths (in black) and the forecast of deaths that would be typical for a normal year (in orange) from all causes.



The figure of 260 000 equates to 437 per 100 000 or indeed 0.437% of the population of South Africa. These deaths are strongly correlated with cases and reported COVID-19 deaths in South Africa and are thought to be largely due to COVID-19. The pattern of excess deaths follows the waves of the infections, increasing and decreasing over the period which suggests a direct association with infections. The researchers estimate that the majority (85% to 95%) of these deaths are directly attributable to COVID-19.

The question one may ask what the implications for the life insurance industry is? Is managing a life insurer in a pandemic not akin to selling home and car insurance in the middle of a hailstorm?

Before the pandemic, the Actuarial Society of South Africa had been working with insurers to study the mortality experience of protection insurance products before the pandemic struck. The Continuous Statistical Investigation (CSI) committee, that was doing the work, saw the opportunity to ask insurance companies to contribute data more frequently, to allow actuaries to observe the impact of the pandemic on the life insurance mortality. The work is focussed on protection products that require full application questionnaire and underwriting procedures to be completed. This excludes

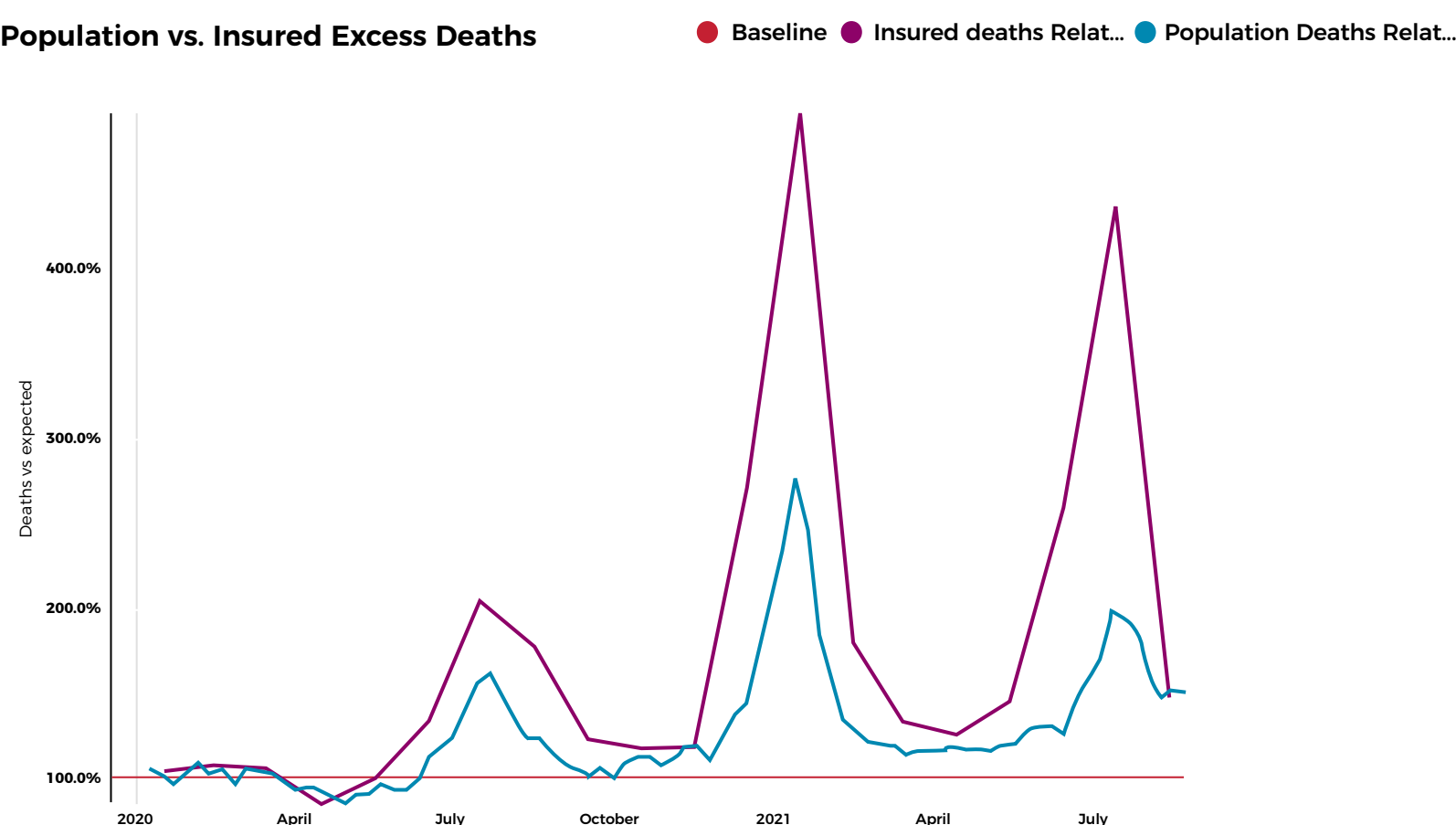
group business, business written with simplified questions, as well as funeral business.

The committee asked companies to contribute claims data as well as exposure data in summarised monthly form from 2018. The committee then used the 2018 and 2019 as a basis to set an expected claim numbers and then compared what has happened in 2020 and 2021. The committee initially released some results on 1 June 2021 but has been updating it ever since. The committee had been trying to keep the updates regular but are somewhat hampered by constraints of the contributing companies.

Below some of the early results of the work is shared. This includes data for the 3rd wave up to the end of August (for companies that have already submitted it). [The online version of the dashboard](#) (available after free registration) includes data before the 3rd wave and will be updated once all companies have submitted.

The graph below shows the expected death rate per mille over the period in red with a confidence interval around it. The actual death rate in blue are well in excess of the expected figures during the three waves.

Population vs. Insured Excess Deaths



In the graph below, the CSI compares the population and insured numbers in a graph. It shows actual vs. expected claims where the expected claims would represent 100% on the graph. In green shows the general population deviation from expected. It is clear that during the 2nd wave of the pandemic population deaths peaked at between 2 and 3 times the expected figures. However, if we look at the insured experience, we can see during the 2nd wave, deaths were in excess of 4x expected deaths. During the 3rd wave deaths are also nearing 4x expected. It should be noted that no allowance for late reported claims have been made in this analysis, so the results may worsen as more data is collected.

Categories	Total value of benefits paid 1 April 2020 to 31 March 2021	Total value of benefits paid 1 April 2019 to 31 March 2020	% change in Rand amount
Individual life	R29.11 bn	R17.12 bn	70%
Group life	R7.98 bn	R4.87 bn	64%
Funeral	R8.74 bn	R5.71 bn	53%
Credit life	R1.75 bn	R1.39 bn	26%
Totals	R47.58 bn	R29.08 bn	64%

In a [further release](#) ASISA goes on to state despite the increase in claims the industry remains well capitalised. It is also noted increased sales of risk policies as well as reduced lapsation of policies (indicating people less willing to lapse their policies). The body goes on to “urge all South Africans to get vaccinated rather than risk death or the long-term debilitating side effects often caused by COVID-19”.

The impact is also evident in many life insurers’ reported results with various life insurers reporting increased COVID-19 provisions and reduced profitability in recent months.

Based on evidence of the continued excellent safety and efficacy of both the Pfizer and Johnson & Johnson vaccines against the Delta variant, life insurers see vaccination as key to restore some sense of “normality” to

life insurance. These are the two vaccines in use in South Africa. Pfizer is thought to be in excess of 95% effective at protection against hospitalisation and death from the Delta variant based on [Public Health England research](#). Furthermore, South Africa’s [own Sisonke trial established](#) that the Johnson & Johnson vaccine is 91.0%-96.2% effective at protecting against death in the presence of Delta.

It is difficult for life insurers to access data on vaccination of their policyholders but some initial findings from Momentum Life indicate that “only 2% of recent deaths claims were for fully vaccinated people”. As the numbers of people that are vaccinated increase, especially amongst the elderly, that number is bound to shift but it is a clear encouraging sign of

The Association for Savings and Investment South Africa (ASISA) which is also the life insurance industry body [has also released claims statistics relating to the COVID-19](#). These demonstrate that the excess death experience is reflected across the full ambit of life cover experience including group covers and funeral policies. The table below summarises the total amounts of benefits paid during the period 1 April 2020 to 31 March 2021 compared to the preceding year. It shows increases across all products with the overall increase in claims of 64%.

the protection offered by vaccines. It should then hardly surprising that insurers are considering [differentiating pricing and rewarding policyholders](#) who are vaccinated in future.

We are starting to understand that COVID-19 will become endemic and something we will continue to live with for some time. There also remains significant uncertainty with regard to the future course of the pandemic and this is uncertainty is heightened by the potential emergence of further variants.

Vaccines offer robust protection against these future uncertainties, but despite this, I’m saddened to still see death claims being paid out to the families of elderly people and healthcare workers who, tragically, could have been vaccinated a long time ago.

LET'S ALL BE SAFE

SPREAD THE WORD, NOT THE VIRUS.

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