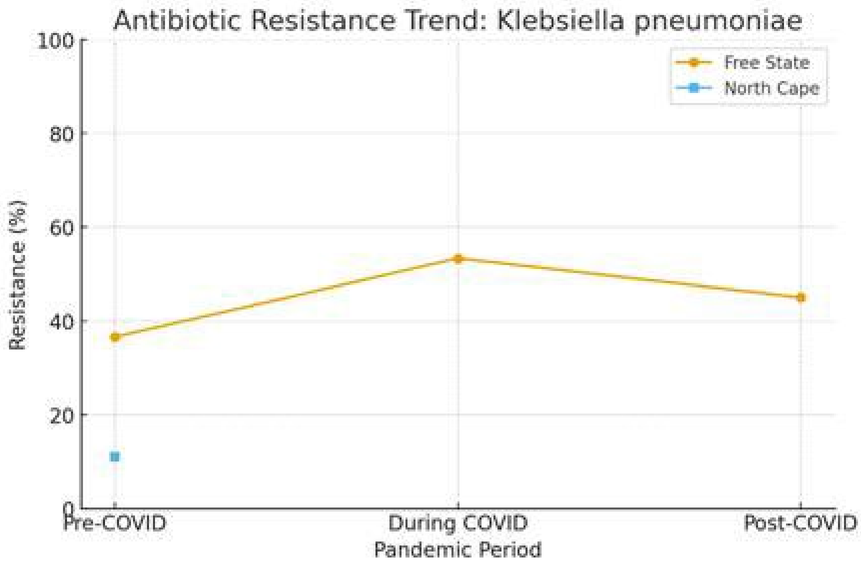

Figure 6: Antibiotic resistance trend of Klebsiella pneumoniae

The resistance of *Klebsiella pneumoniae* was quite high for the Free State pre-COVID-19 (36.65%) compared to the Northern Cape at 11.11%. The lack of samples during and post-COVID-19 for the Northern Cape makes it impossible to compare the resistance of the two provinces. However, the resistance increased in the Free State during COVID-19 (53.33%) and then decreased slightly post-COVID-19 (45.03%).

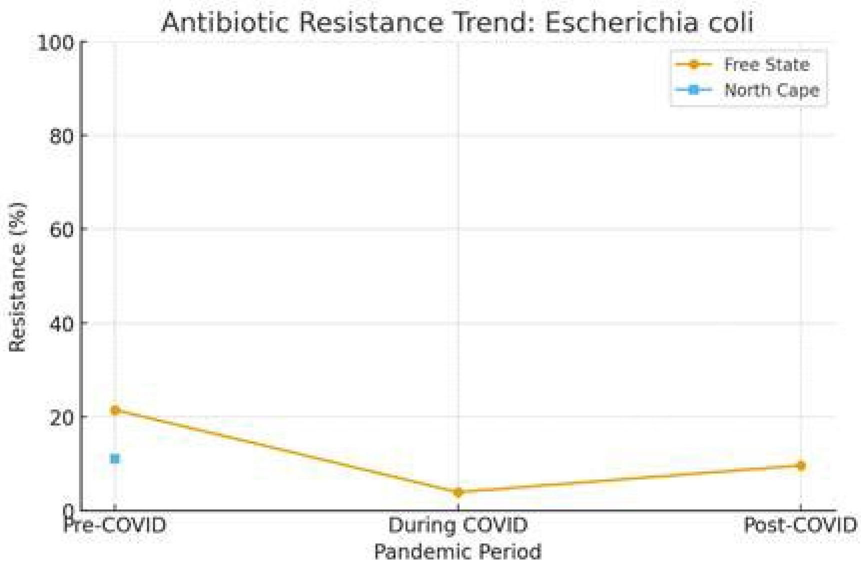

Figure 7: Antibiotic resistance trend of Escherichia coli

The resistance for *Escherichia coli* was slightly higher pre-COVID-19 in the Free State (21.50%) compared to the Northern Cape (11.11%). The resistance decreased tremendously during COVID-19 in the Free State (3.92%), but this could not be compared to the results of the Northern Cape, since there were no samples that tested positively for this bacterium during and post-COVID-19. The resistance increased slightly post-COVID-19 for the Free State (9.62%).

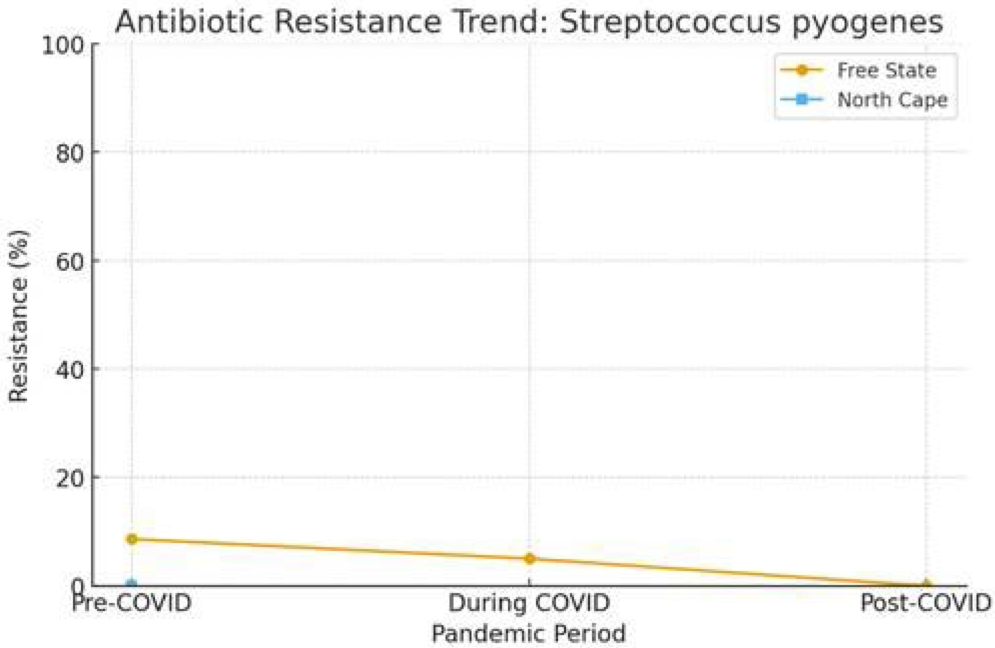

Figure 8: Antibiotic resistance trend of Streptococcus pyogenes

The resistance for *Streptococcus pyogenes* in the Free State showed a steady decline over the three timeframes (8.66% to 5.03%). There were, however, no samples that tested positively for the organism post-COVID-19 and that is why the resistance is 0%. The results of the Free State cannot be compared to those of the Northern Cape, since no samples tested positively for the bacterium in the Northern Cape.

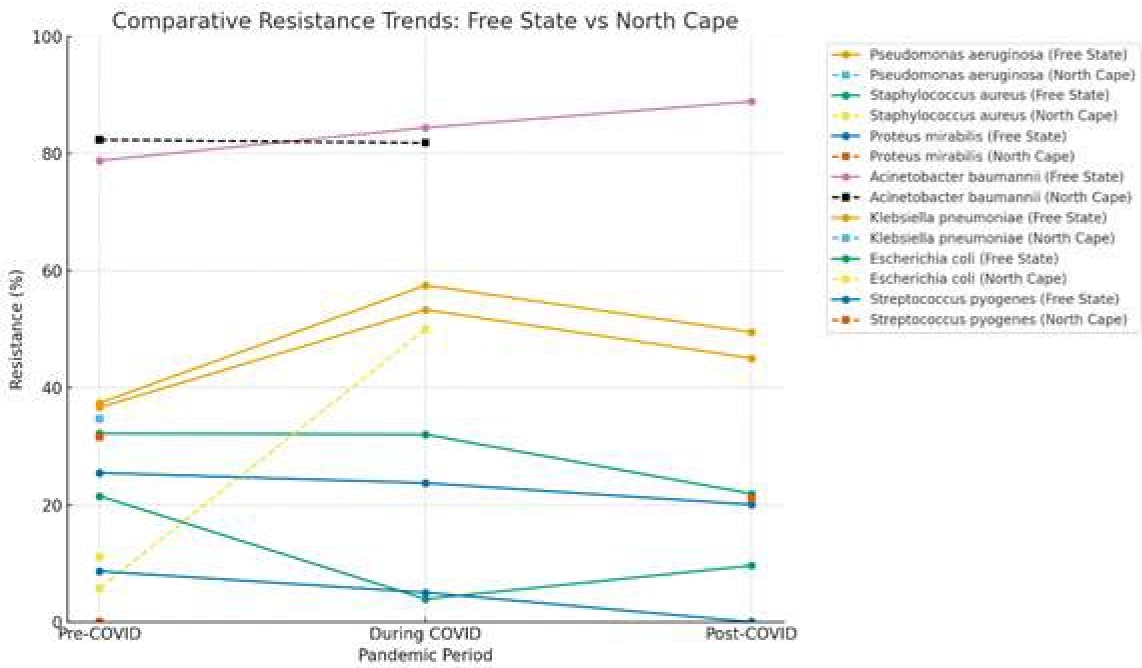

Figure 9: Antibiotic resistance trend of the Northern Cape and Free State

In this graph it is clear that *Acinetobacter baumannii* maintained the highest resistance trend in both provinces (above 80%). The resistance of *Pseudomonas aeruginosa* and *Klebsiella pneumoniae* were much higher in the Free State than in the Northern Cape. The resistance of *Staphylococcus aureus* remained moderate in the Free State while the resistance spiked to 50% during COVID-19 in the Northern Cape.

CHAPTER 5: DISCUSSION AND CONCLUSION

5.1 DISCUSSION

This study was conducted to determine the resistance profile of the bacteria that were isolated from the burn units of the Northern Cape and Free State and then to compare how the resistance pattern changed pre-pandemic (1 March 2018 until 30 February 2020), during the pandemic (1 March 2020 until 30 June 2022), and post-pandemic (1 July 2022 until 31 July 2024). Two objectives were set out for this study; firstly, to determine the bacterial resistance profile of the organisms from the swabs that were sent to the laboratories from the burn units of the public hospitals in the Free State and Northern Cape before, during and after the COVID-19 pandemic; secondly, to determine how the years before, during and after the pandemic compared to one another in terms of the bacterial resistance profile from the swabs that were sent from the burn units to the laboratories. Overall, the findings confirmed that AMR is still an escalating problem in South Africa. This was accelerated by the pandemic while the level post-pandemic has not decreased back to the level's pre-pandemic.

The overall findings shows that COVID-19 had an indirect impact on the microbial ecology of the burn units in these hospitals due to the fact that the resistance levels of the bacteria did not return to the levels it was pre-COVID-19. Due to the loss of the skin barrier on these burn patients and the necrotic tissue, an ideal environment is created for opportunistic infections to occur along with the invasive devices used on these patients (Gulumbe et al., 2023). The results of this study, along with the already existing literature, suggest that COVID-19 amplified the AMR crisis by stopping the antimicrobial stewardship in South Africa and increasing the use of broad-spectrum antibiotics (Khan et al., 2022). This is shown by the increase in resistance that was seen during COVID-19 in the Free State (35.01% to 38.64%) and then the further increase post-COVID-19 (39.59%). The resistance also increased during COVID-19 in the Northern Cape (28.77% to 52.78%), but the levels decreased again post-COVID-19 (21.05%). The decrease that was seen post-COVID-19 in the Northern Cape could be caused by the small sample size of only 19 samples for this timeframe.

As previously stated by literature, during the COVID-19 pandemic there was an increase in antibiotic prescriptions without the necessary testing to confirm the type of infection. Due to the threat of the pandemic and the prioritization of COVID-19 sample testing, the antimicrobial surveillance programs were sidelined, causing a wide range of resistant bacterial strains to dominate in the hospital environments. The results that were stated in this research reinforced the world-wide concern that the pandemic was a catalyst that caused the current AMR crisis to accelerate even more (Langford et al., 2023). This is supported by the results that were seen especially in the Free State. An increase in resistance was seen during COVID-19 in the Free State (35.01% to 38.64%) and then a further increase post-COVID-19 (39.59%). The continual high levels of resistance that was seen post-COVID-19 suggest that the results of the ecological changes during the pandemic were not temporary, but this may have altered the baseline of the resistance in the South African burn units permanently. The resistance level in the Free State continued to increase post-COVID-19 (39.59%) and remained high. The resistance decreased post-COVID-19 in the Northern Cape (21.05%), but the decrease could be caused by the low sample size for this timeframe.

When comparing the sample size of the two provinces it is quite clear that the Free State had a much larger sample size (1 549 samples) compared to the Northern Cape (57 samples). However, it was still clear that the resistance in the Free State increased during the pandemic (from 35% to 38.6%) and continued to increase post-COVID-19 (39.6%). The resistance in the Northern Cape showed a different pattern, since the resistance rose drastically during COVID-19 (from 28.8% to 52.8%) and then decreased again sharply post-COVID-19 (21.1%). The decrease in resistance for the Northern Cape could be misleading, since there was only one sample post-COVID-19. The increase in resistance during the pandemic is consistent with the literature, which states that there was an increase in the samples sent to laboratories, increased broad-spectrum prescriptions and reduced ASP (Khaznadar et al., 2023).

It is important to take note of the difference in sample size between the Northern Cape and the Free State. The larger sample size of the Free State provides a more stable and reliable resistance pattern and organism prevalence, while the smaller size in the Northern Cape could exaggerate certain fluctuations in results (Farley et al., 2018). The hospitals in the Free State received higher patient loads due to the large population, which increased the risk of the spread of AMR (Davids, 2021). The Northern Cape is more rural with a much smaller population compared to the Free State.

The difference in the sample size for the two provinces could also be caused by a difference in staffing levels, healthcare infrastructure and laboratory testing capacity. Since the hospitals in the Free State serve a larger population size it could also mean that they have a more constant and larger flow of samples, which could also explain the larger sample size. The Northern Cape has smaller hospitals and a smaller population size and during the pandemic, these hospitals could have been overwhelmed, focusing solely on COVID-19 cases, which could contribute to the small sample size. When comparing the results of the Northern Cape it should be done with caution, since it does not necessarily reflect the decline in bacterial prevalence, but more likely the surveillance gaps in this province. However, the increase in resistance that is seen in the Northern Cape during COVID-19 still demonstrates how even a slight misuse in antibiotic use could still rapidly elevate the resistance levels of different bacteria. The large difference in sample size highlights the unequal burden of AMR across South Africa, especially that the more rural provinces might be more vulnerable to the shifts in resistance (Health, 2018).

Pseudomonas aeruginosa and *Staphylococcus aureus* were the most commonly found isolates from the swabs from burn wounds due to their ability to colonize the skin. These are well-documented organisms in burn units (Gulumbe et al., 2023). *Proteus mirabilis*, *Acinetobacter baumannii* and *Klebsiella pneumoniae* were also prevalent in the burn wound swabs, due to these bacteria causing hospital-acquired infections (Khaznadar et al., 2023).

Pseudomonas aeruginosa resistance rose sharply during COVID-19 (from 37.39% to 57.49%) in the Free State. These results confirm what has been said in the literature that during COVID-19 there was an increase in the prescriptions of broad-spectrum antibiotics without the confirmation of bacterial co-infections, which then caused an increase in resistance (Comelli et al., 2022). Post-COVID-19, the results only decreased slightly (49.49%), but it did not reach pre-COVID-19 levels, which shows the persistence of these bacteria in the hospital environments. In the Northern Cape the resistance was similar to the Free State pre-COVID-19 (34.72%), but there were no isolates during and post-COVID-19 to compare this result with.

It is quite concerning that the resistance continued to be high post-COVID-19, since this could suggest that the resistant strains of *Pseudomonas aeruginosa* have become embedded in the hospital environment and are difficult to eradicate. Since the levels post-COVID-19 has not decreased to the baseline level of pre-COVID-19, this raises concerns about whether the current infection control measures are effective. Moreover, it highlights the need for antimicrobial stewardship programmes to be re-instated.

The increase in resistance that is seen for *Pseudomonas aeruginosa* is concerning due to the high resistance to many different antibiotics (Med, 2019). This organism commonly causes septicaemia in burn-wound patients and, if not treated promptly, it could lead to a life-threatening infection (Dadgoster, 2019). The remaining high levels of resistance seen post-COVID-19 indicate that not just an ecological shift had occurred, but that this shift has now been entrenched in these environments, which could be due to the resistant colonies that established dominance in the hospital environments (Khaznadar et al., 2023). The findings for this organism confirm global concerns, since the organism is known to thrive in a hospital environment and evade antibiotic therapy (Comelli et al., 2022).

The trajectory of *Staphylococcus aureus* is slightly different. The resistance remained constant pre- and during COVID-19 (32.2% and 32%) in the Free State but then declined drastically post-COVID-19 (21.9%). This decrease in resistance post-COVID-19 could be caused by the increase in infection control measurements that were put in place with hygiene control during the pandemic (Shomuyiwa et al., 2022). However, the resistance increased from 5.77% to 50% during the pandemic in the Northern Cape. Post-COVID-19 no samples tested positively for *Staphylococcus aureus* and therefore the resistance was 0%.

The decline in resistance that is seen in the Free State post-COVID-19 could reflect the effect of the use of personal protective equipment such as masks, increased hand hygiene and environmental decontamination, especially in hospitals during this pandemic (Khan et al., 2022). It is known that *Methicillin-resistant Staphylococcus aureus* is one of the most commonly found hospital-acquired pathogens, especially in South Africa, but strict hygiene protocols could decrease the transmission (Farley et al., 2018). The increase in resistance that was seen during the pandemic in the Northern Cape is concerning, but this could be due to a single outbreak in a facility and not necessarily a provincial trend when looking at the small sample size. The disappearance in isolates in the Northern Cape could just reflect the absence in tested samples and not necessarily the eradication of the organism (National Library of Medicine, 2021).

The stricter patient isolation measures and hospital hygiene that were put in place during the pandemic could be the reason for the decline in the resistance seen in the Free State. These measures could have prevented the transmission of *methicillin-resistant Staphylococcus aureus,* which could cause a permanent decrease in the prevalence of this resistant organism. However, the sudden spike in the Northern Cape to 50% during the pandemic could indicate a sudden outbreak in one hospital or the burn unit of one of these hospitals, amplified by the small sample size of the Northern Cape. Due to no samples post-COVID-19 in the Northern Cape, it is not possible to determine if this sudden increase is an anomaly or a larger regional increase.

Acinetobacter baumannii had the highest resistance in the Free State (pre-COVID-19 78.79%, during 84.41%, post 88.89%) and Northern Cape (pre-COVID-19 82.35%, during 81.82%) when compared to other bacteria. This organism's resistance reflects its persistent presence in the hospital environment along with its ability to colonize medical equipment and its resistance to a wide variety of antimicrobials. Therefore, the resistance was expected, and these results reflect other reports (Khoshbakht et al., 2022). This organism has already been mentioned as a high-priority pathogen by the WHO (Med, 2019).

The constantly high resistance of *Acinetobacter baumannii* as stated is quite concerning, since it appears that the bacterium is entrenched in the hospital environment, particularly the burn units (Dadgoster, 2019). The bacterium forms biofilms on surfaces and it is therefore quite difficult to eradicate (Khaznadar et al., 2023). The nearly 90% resistance that is seen in the Free State post-COVID-19 shows that this is a threat due to the limitations in therapeutic options (Med, 2019). *Carbapenem*-resistant *Acinetobacter baumannii* outbreaks in South Africa have been linked to shortages of single-use equipment, also due to poor infection control and prevention (National Library of Medicine, 2021). The presence of the pandemic likely aggravated this, since most of the resources and staff were used for COVID-19 cases and therefore the burn units could have been under-monitored. The persistent increase in resistance post-COVID-19 suggests that the decrease in antimicrobial stewardship during the pandemic allowed resistant strains to dominate in the hospital environment (National Library of Medicine, 2021).

The same trend could be seen with *Klebsiella Pneumoniae* as was seen with *Acinetobacter baumannii* in the Free State, where the resistance increased drastically during COVID-19 (from 36.65% to 53.33%) and then decreased slightly post-COVID-19 (45.03%). As stated by the literature, there was an increase in the prescription of broad-spectrum antibiotics during the pandemic to patients, although bacterial infections were not confirmed, causing an increase in resistance during COVID-19. Post-COVID-19 the resistance decreased slightly as other organisms re-emerged and the excessive use of antibiotics decreased (Comelli et al., 2022). Due to the heavy reliance on carbapenems and cephalosporins during COVID-19, the rise in resistance is not surprising (Langford et al., 2023). This bacterium has already been classified by the WHO as a critical priority due to the bacterium's ability to disseminate the genes of carbapenems, which then cause the bacterium to gain resistance to last-line agents (Med, 2019). The slight decrease in resistance seen post-COVID-19 could be attributed to the normalization in prescription patterns in the hospitals, but the fact that the level is still above pre-COVID-19 levels confirms that this organism is resilient and difficult to eradicate (Djuikoue et al., 2023).

Klebsiella pneumoniae forms biofilms in the hospital environment as well as on devices that are used in the hospital setting. This is particularly concerning, since this bacterium is clearly embedded in the burn units of these hospitals and is particularly dangerous to these susceptible burn-wound patients (Djuikoue et al., 2023). The continual high levels of resistance seen post-COVID-19, even though the overprescription of antibiotics have decreased, could be due to environmental contamination in these hospitals. This shows that there is a need for active environmental surveillance along with the reinstatement of the antimicrobial stewardship programmes (Khan et al., 2022).

A completely opposite resistance could be seen with *Proteus mirabilis* where the resistance decreased slightly across the three timeframes. This could be caused by the fact that *Proteus mirabilis* is not a pathogen commonly seen in burn units when compared with *Pseudomonas aeruginosa* and *Staphylococcus aureus* (Khaznadar et al., 2023). When comparing the resistance of the other organisms, the results fluctuated across the three timeframes and also across all of the bacteria. The reason for this could, however, be due to the small sample sizes of these organisms.

Proteus mirabilis is more commonly seen with urinary tract infections, but it can become an opportunistic pathogen in wounds, especially where there is an increase in contamination risk or with prolonged catheterisation (Shomuyiwa et al., 2022). Most of the broad-spectrum antibiotics that were used during COVID-19 were for Gram-negative bacteria and therefore *Proteus mirabilis* could have experienced less selective pressure, causing the decrease in resistance (Langford et al., 2023). The lower prevalence of the bacterium in the burn units decreases the selective pressure for multidrug resistance. During the pandemic improved infection prevention measures were put in place. This could have improved catheter care, which decreased the cross-transmission to the burn wounds of the patients (Khadse, Ugemuge, & Singh, 2023).

Enterobacter cloacae complex and *Enterobacter aerogenes* are commonly seen environmental organisms that colonize medical devices, disinfectant solutions and even hospital plumbing. Once these organisms are found in an environment such as burn units, they can persist for long periods of time and cause outbreaks (Gulumbe et al., 2023). This pathogen is an opportunistic pathogen that can commonly be seen in immunocompromised patients, and that is why it is seen in this study with burn-wound patients (Med, 2019). These burn patients are repeatedly exposed to antibiotic use and prolonged hospitalization, which create the perfect environment for COVID-19 to thrive in (Langford et al., 2023).

Enterobacter cloacae subsp. cloacae showed a gradual decrease in resistance over the three timeframes in the Free State. The resistance decreased slightly during COVID-19 from 38.32% to 37.9% in the Free State and then decreased even further post-COVID-19 (20%). In the Northern Cape the resistance was 23.53% pre-COVID-19 and there were no further samples after this timeframe with which to compare this result. It is, however, close to the resistance level in the Free State. The resistance for *Enterobacter aerogenes* was quite similar. The resistance was high pre-COVID-19 in the Free State (42.11%), which then decreased post-COVID-19 (31.25%), but there were no samples during COVID-19 to show a clear trend. There were also only samples for pre-COVID-19 in the Northern Cape, and the resistance was slightly lower than that of the Free State (17.65%). The difference in resistance over the three timeframes and also between the two provinces could be due to the variations between the different wards and hospitals in infection control efficacy.

The resistance of *Escherichia coli* rose slightly during COVID-19, likely due to the overuse of antibiotics such as cephalosporins. Post-COVID-19, the levels decreased, but it did not go back to pre-COVID-19 levels, which could have been caused by a shift in resistant ecology (Farley et al., 2018). The presence of this bacterium is not commonly seen in burn wound swabs and could be associated with a secondary infection from urinary or gastrointestinal sources from devices such as catheters (Djuikoue et al., 2023). The trend in resistance that is seen corresponds with the literature that states that there has been a surge in extended-spectrum-beta-lactamase producing *Escherichia coli* during COVID-19, due to the increase in the use of antibiotics such as fluoroquinolone and cephalosporin (Khoshbakht et al., 2022). This is seen as a great challenge, since this bacterium is able to transfer its plasmids carrying resistance genes to other bacteria that are also Gram-negative such as *Proteus mirabilis* or *Klebsiella pneumoniae* (Khoshbakht et al., 2022).

Serratia spp. was less commonly isolated in this study, but the trend in resistance correlated with those of other Gram-negative pathogens, since there was an increase in resistance during COVID-19. This pathogen causes opportunistic infections and are commonly found in moist hospital environments. Although the small sample size limits the proper interpretation, the presence of this pathogen in the burn units shows that proper environmental hygiene and infection prevention have not been followed. This bacterium has been noted to contaminate soap dispensers and decontamination devices in hospital environments and since these devices are commonly used in burn units, this could be the source of the spread of the bacterium (Khaznadar et al., 2023).

When comparing the overall resistance across both provinces, the same trajectory can be seen as the resistance increased during the pandemic. In the Free State it rose slightly (35.01% to 38.64%) and continued to rise post-COVID-19 (39.59%). The Northern Cape, however, showed a slightly different trajectory post-COVID-19, as the resistance decreased (21.05%) even below pre-COVID-19 levels (28.77%). The results should be considered with caution due to the extremely low sample size during and especially post-COVID-19.

The increase in resistance during COVID-19 could be caused by the overuse of antibiotics and the pause that was placed on the ASP during this time (Langford et al., 2023). The fact that the overall resistance did not return to pre-COVID-19 levels could be caused by the consistent presence of these bacteria in hospitals, as they cause hospital-acquired infections that are not easy to eradicate (Comelli et al., 2022). These findings correspond with literature that confirms that COVID-19 produced ideal conditions for the prolonged increase in AMR (Shomuyiwa et al., 2022).

The findings of this study support the fact that *Pseudomonas aeruginosa* and *Acinetobacter baumannii* are MDR organisms that are entrenched in the burn units in hospitals. The burn patients are extremely vulnerable to these due to their extensive wound exposure, extended hospital stays and the use of invasive devices. The increase in resistance that was seen during COVID-19 is due to the overprescription of antibiotics during the pandemic and the halt that was put on the antimicrobial stewardship programmes (Khan et al., 2022).

The continual increase in resistance of the organism post-COVID-19 suggests that a long-term ecological shift has occurred in the hospital microbial population. It is known that the resistant strains found in hospitals are particularly difficult to eradicate, especially in high-risk environments such as burn units (Dadgoster, 2019). This highlights the urgency of the matter to firstly strengthen and then re-establish the antimicrobial stewardship programmes in South Africa (National Library of Medicine, 2021).

Overall, these findings across the multiple organisms showed that the COVID-19 pandemic placed stress on the antibiotic stewardship and infection prevention in South Africa, particularly in the burn units. Certain species such as *Acinetobacter* and *Klebsiella* showed an increase in resistance under the high levels of antibiotic use, while for other bacteria such as *Enterococcus* and *Proteus,* the resistance remained lower, but they still acted as reservoirs for the transfer of resistant genes. These results show that AMR is not one single problem, but a complex system that is influenced by environmental factors, antibiotic use and patient vulnerability (National Library of Medicine, 2021).

Since there are quite a few pathogens that have the ability to form biofilms in the hospital environment, patient wounds and even invasive devices, it is important to note that even if the number of unnecessary prescriptions are decreased to how it was before the pandemic these resistant bacteria can still remain in the hospital environment and cause infections. Therefore, while it is necessary to reinstate the antibiotic stewardship programmes in the hospitals, it is also important to add additional intervention strategies such as the use of antimicrobial dressing in burn wound patients and the regular cleaning of equipment that are used on these patients to prevent the further spread of the bacteria (Djuikoue et al., 2023).

5.2 CONCLUSIONS

Overall, this study has shown that during COVID-19, the AMR increased in the burn units of the Northern Cape and the Free State. Post-pandemic it is shown that the resistance levels remained higher than the levels pre-pandemic. The organisms that were the most concerning was *Pseudomonas aeruginosa*, *Acinetobacter baumannii*, and *Klebsiella pneumoniae* due to the persistence in elevated resistance levels. The resistance patterns varied across the different antimicrobial classes, with the most worrisome trends seen among the last-resort antimicrobials. This highlights the urgency of the matter to firstly strengthen and then re-establish the antimicrobial stewardship programmes in South Africa, and then also to prioritize the infection prevention measure in the burn units. If no intervention takes place, the resistant infections that are currently in these burn units will continue to threaten and cause further harm to these burn unit patients that are already vulnerable, as well as further strain the South African healthcare systems. Future research should be done to determine exactly what antibiotic classes are no longer effective against what bacteria and to determine what options of antibiotics are still available for different organisms. How antibiotics are used and to what extend should also be studied in South Africa to determine if and how these antibiotics are being misused.

5.3 LIMITATIONS

Two limitations for this study should be acknowledged. Firstly, since this study was retrospective, the data therefore relied on the laboratory submissions that were reduced due to the prioritization of the viral samples during COVID-19. Secondly, the small sample size of the Northern Cape during and after COVID-19 limited the comparison of the provinces.

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Central University of Technology, Free State

APPENDIX A: LETTER TO ETHICS COMMITTEE

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS HEALTH SCIENCES

Health Sciences Research Ethics Committee

28-May-2025

Dear **Mrs Chene Beetge**

Ethics Clearance: **The prevalence of multidrug-resistant antimicrobials in the burn units of three hospitals in the Free State and Northern Cape before, during and after the COVID-19 pandemic (1 March 2018 - 31 July 2024).**

Principal Investigator: **Mrs Chene Beetge**

Department: **CUT - Central University of Technology**

Submission Page

APPLICATION APPROVED

Please ensure that you read the whole document.

With reference to your application for ethical clearance with the Faculty of Health Sciences, I am pleased to inform you on behalf of the Health Sciences Research Ethics Committee that you have been granted ethical clearance for your project.

Your ethical clearance number, to be used in all correspondence is:**UFS-HSD2024/1262/2705**

The ethical clearance number is valid for research conducted for one year from issuance. Should you require more time to complete this research, please apply for an extension.

We request that any changes that may take place during the course of your research project be submitted to the HSREC for approval to ensure we are kept up to date with your progress and any ethical implications that may arise. This includes any serious adverse events and/or termination of the study.

A progress report should be submitted within one year of approval, and annually for long term studies. A final report should be submitted at the completion of the study.

Research conducted in any Department of Health facility: Researchers are required to sign and return the HSREC approval letters to the provincial Department of Health where they applied. It is also a requirement for researchers to submit electronic copies of their final research findings, and/or make a presentation of their findings and recommendations at departmental research days when and where indicated.

The HSREC functions in compliance with, but not limited to, the following documents and guidelines: The SA National Health Act. No. 61 of 2003; Ethics in Health Research: Principles, Structures and Processes (2015); SA GCP(2020); Declaration of Helsinki; The Belmont Report; The US Office of Human Research Protections 45 CFR 461 (for non-exempt research with human participants conducted or supported by the US Department of Health and Human Services- (HHS), 21 CFR 50, 21 CFR 56; CIOMS; ICH-GCP-E6 Sections 1-4; International Council for Harmonisation (ICH) Harmonised Guideline, Integrated Addendum to ICH E6(R1), Guideline for Good Clinical Practice (GCP) E6(R2), 2016, SAHPRA Guidelines as well as Laws and Regulations with regard to the Control of Medicines, Constitution of the HSREC of the Faculty of Health Sciences.

The Principal Investigator (PI) bears final responsibility for the RIMS application. In the event of any misconduct or improper activities perpetuated by a third party, the PI will be held vicariously liable. The HSREC will bear no responsibility or liability for any actions of a PI and/or third party or breach of confidentiality caused by the PI and/or third party.

For any questions or concerns, please feel free to contact HSREC Administration: 051-4012650/9860 or email EthicsFHS@ufs.ac.za.

Thank you for submitting this proposal for ethical clearance and we wish you every success with your research.

Yours Sincerely

Dr. C. Armour (Barrett)
Chairperson: Health Sciences Research Ethics Committee

Health Sciences Research Ethics Committee
T: +27 (0)51 401 2650/9860 | E: ethicsfhs@ufs.ac.za
IRB 00011992; REC 230408-011; IORG 0010096; FWA 00027947

APPENDIX G: TURN IT IN SUMMARY

Beetge C Masters

ORIGINALITY REPORT

7%	5%	4%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

MATCH ALL SOURCES (ONLY SELECTED SOURCE PRINTED)

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Internet Source

Exclude quotes	Off	Exclude matches	Off
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