International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 20s, 2025
https://theaspd.com/index.php

Has COVID-19 Shifted Staphylococcus Aureus Resistance? Five Years Of Surveillance Across Kwazulu-Natal Hospitals

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Received -29/07/2025
Acceptance- 02/08/2025

Abstract
Staphylococcus aureus, particularly methicillin-resistant S. aureus (MRSA), remains a significant cause of morbidity and mortality in intensive care units (ICUs) worldwide. The COVID-19 pandemic introduced unprecedented changes to hospital infection control, antimicrobial usage, and all patient profiles factors that may influence resistance trends.
***Objectives**:This study aimed to evaluate temporal shifts in all wards-associated Staphylococcus aureus isolates over a five-year period (2018–2022) across six tertiary hospitals in KwaZulu-Natal, South Africa, with a specific focus on comparing pre- and post-COVID-19 patterns.*
***Methods**:We conducted a retrospective, multicentre analysis of microbiological records from all admissions in six public hospitals. S. aureus isolates were stratified by year, resistance phenotype (e.g., MRSA vs. MSSA), and demographic variables. The timeline was divided into pre-COVID-19 (2018–2019) and post-COVID-19 (2020–2022) periods. Trends were analysed using descriptive statistics and regression modelling.*
***Results**:A total of 11,664 S. aureus isolates were identified. The proportion of MRSA fluctuated across the years, with a slight increase on MRSA prevalence following the onset of COVID-19. Differences in antimicrobial susceptibility profiles and all-wards patient demographics were also observed between the two periods. A higher infection rate was observed among male patients in both study periods. Antimicrobial susceptibility testing showed high sensitivity to linezolid, teicoplanin, fusidic acid, and vancomycin, with notable resistance to cefoxitin and penicillin-ampicillin.*
***Conclusion**:These findings suggest that COVID-19 have not influenced the epidemiology of Staphylococcus aureus as the slight increase is not statistically prevalence in all-wards settings, with fluctuating measurable changes in resistance trends post-pandemic. Ongoing surveillance and adaptive infection control policies are essential to mitigate future AMR risks in critical care environments.*
***Keywords**: Staphylococcus aureus, MRSA, ICU, antimicrobial resistance, COVID-19, retrospective study, KwaZulu-Natal, South Africa, infection control.*

INTRODUCTION

In the early 1800s Staphylococcus aureus (S. aureus) was identified as a causative organism isolated from wound pus (Masalha et al.,2001). Staphylococcus aureus has then over the years emerged as problematic organism, over the last decade it was mostly associated with nosocomial infections causing rapidly progressing and potentially fatal conditions, severe pneumonia, necrotizing fasciitis, endocarditis, osteomyelitis, sepsis, and toxic shock syndrome (Monecke, 2011). S. aureus strain emerged and developed resistance to know best beta-lactam antibiotics know as methicillin, making infections difficult to treat and often requiring more complex and costly therapeutic interventions (Chambers et al.,2009). This strain named methicillin-resistant-Staph aureus) MRSA remains a major global public health challenge, particularly within hospital settings where it contributes to significant morbidity, mortality, and healthcare costs (Kourtis et al.,2019).

More risk is experienced in high in critical care environments such as intensive care units (ICUs), where patients are often immunocompromised, undergo invasive procedures, and have prolonged hospital stays as some of factors that increase susceptibility to hospital-acquired infections (Vincent et al.,2009). People may become infected with MRSA due to improper use of antibiotics such as taking them without a prescription, using them too frequently, not following medical advice, stopping treatment too soon, or nonadherence to doses (CDC, 2019). Additionally, MRSA can be transmitted through activities like

sharing needles, having medical devices such as catheters or tubes inserted, or while recovering from surgical procedures or burn injuries, all of which can increase the risk of infection (TPCHD, 2018).
South Africa, like many other countries, continues to struggle with the burden of antimicrobial resistance, including MRSA (Perovic et al.,2018). A two-year study done at South India tertiary-care hospital over 3 years (2013 -2015), reported high prevalence MRSA in males than female's patient (Arunkumar et al., 2017). Another study conducted in Nigeria to determine the presence of MRSA infection among hospitalised wound patients in a tertiary hospital in Enugu Metropolis, MRSA was found to be 22,3%, and females were more likely to be affected than males, with a percentage of 12,7% and 9,6%, respectively (Chukwueze et al., 2022). A study carried out in Asmara between February and May 2016 similarly reported a higher frequency of Staphylococcus aureus being isolated from pus samples compared to blood specimens (Eyob et al., 2019) The prevalence of MRSA rates were found to be 23% in a study done between 1999 to 2002 at two academic hospitals in Johannesburg South Africa (Perovic et al., 2006). Another study conducted from January to December 2013 reported the prevalence of MRSA to be 19% in Johannesburg from patients at Chris Hani Baragwaneth Academic Hospital South Africa (Raphulu et al., 2023). In a study conducted at the Addington Hospital in KZN for a period of one year, MRSA was found to be 8,04% and more males than females were affected (Dube et al., 2024). KwaZulu-Natal (KZN), one of the most populous provinces in South Africa, has a high burden of infectious diseases and a strained healthcare system, making it particularly vulnerable to the spread of resistant pathogens like MRSA (Naidoo et al.,2013). The drug of choice for MRSA infection is vancomycin, but some studies in South Africa revealed that some MRSA strains are now resistant to vancomycin and teicoplanin (Ferraz et al., 2000). This suggests that the knowledge of antimicrobial resistance in S. aureus is essential for making the best choices of formularies and infection control procedures.

Despite infection control efforts, the prevalence of MRSA remains substantial in many healthcare facilities. The prevalence of MRSA during pre-COVID-19 and post-COVID-19 in South Africa remains less documented, Zafel et al., (2023) reported that no change was observed during the pandemic in Australia during the COVID-19 period. One can't just conclude this could be the case for South Africa and KwaZulu-Natal. This warrant a need a need for proper monitoring and determination of provincial diseases monitoring more especially ESKAPE group. As such, regional variances in healthcare procedures and the epidemiology of MRSA could lead to different findings even in our country (Tham et al., 2022). This study aimed to investigates the presence and trends of MRSA among patients admitted six public hospitals in KZN over a five-year period (2018–2022), encompassing both pre- and post-COVID-19 eras. By analysing MRSA isolation rates and specimen types, the study will provide insight into the ongoing impact of MRSA in critical care settings.

METHODOLOGY

Study location

The study was conducted at the King Edward VIII Hospital Laboratory, operating under the National Health Laboratory Service (NHLS). Clinical isolates were collected from six public-sector hospitals across KwaZulu-Natal (KZN), South Africa. These included King Edward VIII Hospital, a combined regional and tertiary care institution; Inkosi Albert Luthuli Central Hospital, a tertiary and quaternary referral center in Durban; Addington Hospital, a regional facility situated in South Beach, Durban; Mahatma Gandhi Memorial Hospital, serving the Phoenix area; Prince Mshiyeni Memorial Hospital, a major healthcare provider in the Durban South region; and Northdale Hospital, a regional hospital located in Pietermaritzburg.
Study population and sample size
The research method was retrospective quantitative, and primary data were collected for the six mentioned hospitals in the study location via Central Data Warehouse (CDW) with permission from Academic Affairs and Research Management System (AARMS). Data were received from the CDW for MRSA isolates detected from 2018 to 2022 for patients in all wards of the six hospitals.

Data collection and quality control

This research include data from 1 January 2018 to 31 December 2022. After approval was received for data from the (NHLS) Academic Affairs and Research Management System (AARMS) for data use and HSREC, data was obtained from CDW. The data collected was the information of tests for patients admitted in all wards at the six hospitals over 5 years period. Data included positive samples for S. aureus and their antimicrobial susceptibility testing to check the presence of MRSA amongst those.

Inclusion criteria

Only patients 18 years of age and older were included in the study. Only patients results that show Staphylococcus aureus as the causative of the diseases from all-wards from January 2018 to December 2022 the specimens.

Exclusion criteria

Patients younger than 18 years, data that were duplicates of previous samples and data that were not fully filled in due to wrong patient details. Other results which are not from the specified period and are not associated with our organism of interest being Staphylococcus aureus.

Stats analysis

On this study inferential statistics was performed, chi-square test was used because the sample size was larger than 5, and purposely to assess whether there are statistically significant differences in MRSA proportions between pre- and post-COVID-19 periods. For stats purpose

- Null Hypothesis (H0): No difference in MRSA proportions between pre- and post-COVID-19.
- Alternative Hypothesis (H1): Significant difference in MRSA proportions between periods.

Then this was followed by calculation of the p-values per hospital and overall, whereby if the $p < 0.05$ this would suggest a statistically significant change in MRSA prevalence. Further scientific analysis done was the Phi Coefficient (Φ) / Cramér's V, this was done purely to measure the effect size of the association between COVID-19 period (pre/post) and MRSA status.

The Phi was done as 2x2 tables, in this study to show the strength of association and if the following value(s) results that would be interpreted as indicated below.

- 0 = no association
- 1 = perfect association

Another option would have been to employ the Cramér's V, in most cases it is used for larger tables.

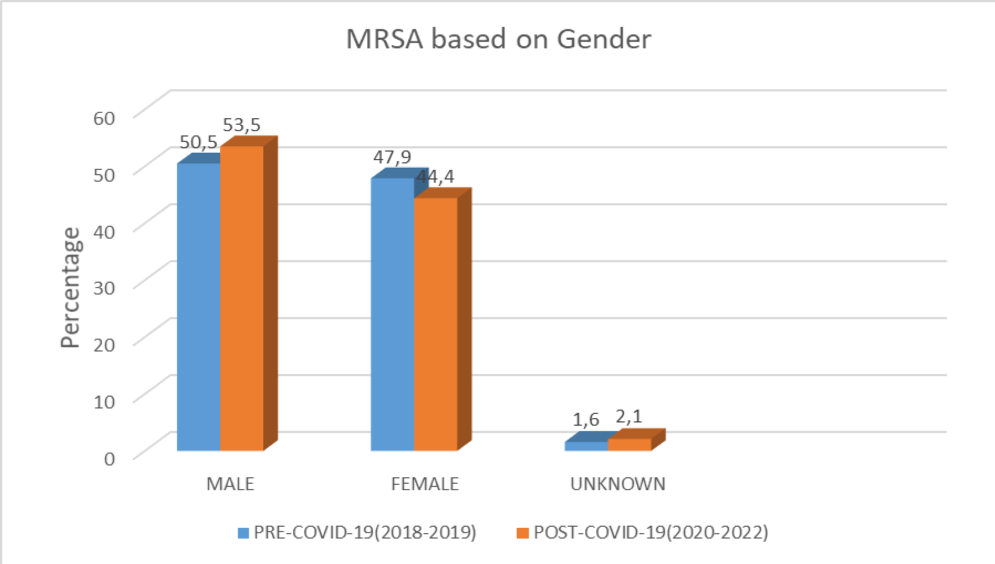
RESULTS

A total of 11,664 S. aureus isolates as indicated on table 1 below were collected from various wards across six hospitals and were analysed using IBM SPSS version 27 for both descriptive and inferential statistical analysis. The study aimed to investigate the prevalence of MRSA in all wards. Methicillin-resistant-Staphylococcus aureus accounted for 2357 cases over both periods and non-MRSA cases were 9307.

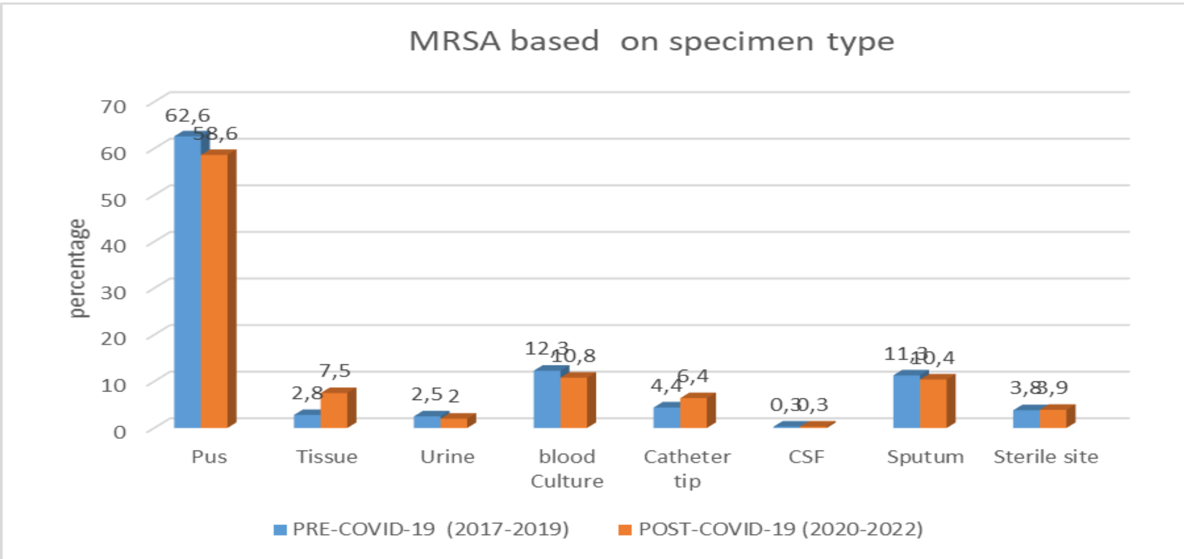
Table 1 Cross tabulation analysis (2x2 Contingency Table (ALL hospitals combined))

Period	MRSA cases	Non-MRSA cases	Total
Pre-COVID-19	1044	4321	5365
Post-COVID-19	1313	4986	6299
Total	2357	9307	11664

Methicillin-resistant Staphylococcus aureus (MRSA) cases were fairly evenly distributed between males (50.5%) and females (47.9%) during the pre-COVID-19 period (2017–2019) as shown by graph 1. However, in the post-COVID-19 period (2020–2022), a higher proportion of MRSA cases was observed among males (53.5%), while the proportion among females declined to 44.4%, indicating a shift in gender distribution following the pandemic.



Graph 1: Gender-based distribution of Methicillin-resistant Staphylococcus aureus (MRSA) cases across six hospitals in KwaZulu-Natal (KZN)



Graph 2: Distribution of Methicillin-resistant Staphylococcus aureus (MRSA) isolates by specimen type from patients attending six KZN hospitals during the pre-COVID-19 (2018–2019) and post-COVID-19 (2020–2022) period

Graph 2 illustrates the distribution of specimen types from which Methicillin-resistant Staphylococcus aureus (MRSA) was isolated across six KwaZulu-Natal hospitals, comparing the pre-COVID-19 period (2018–2019) with the post-COVID-19 period (2020–2022). Prior to the pandemic, pus samples accounted for the majority of MRSA isolates, comprising 62.6% (n = 654), which slightly decreased to 58.6% (n = 769) in the post-COVID-19 period. Blood cultures represented 12.3% of MRSA isolates before COVID-19 and 10.8% after. Other specimen types each contributed ≤11% of the total MRSA cases. Notably, MRSA detection in cerebrospinal fluid (CSF) remained consistently low at 0.3% in both study periods.

Statistics analysis

Table 2: Descriptive analysis of Staphylococcus aureus across six hospitals in KZN

Hospital	Pre SA	Pre MRSA	Pre %	Post SA	Post MRSA	Post %	Difference (%)
Addington	952	52	5.46%	1411	69	4.89%	-0.57%
Inkosi Albert Luthuli Central	934	329	35.23%	1047	351	33.51%	-1.72%

Hospital	Pre SA	Pre MRSA	Pre %	Post SA	Post MRSA	Post %	Difference (%)
King Edward VIII	317	137	43.22%	427	143	33.49%	-9.73%
Mahatma Gandhi	146	93	63.70%	143	84	58.74%	-4.96%
Northdale	2771	315	11.37%	2941	529	17.98%	+6.61%
Prince Mshiyeni Memorial	244	118	48.36%	330	137	41.52%	-6.84%

SA: Staphylococcus aureus, MRSA (Methicillin-resistance-Staphylococcus aureus)

In Northdale hospital, MRSA prevalence significantly increased from 11.37% to 17.98% (refer to table 2) post-COVID-19 ($p < 0.01$, $\Phi = 0.09$), indicating a small-to-moderate positive association between the pandemic period and MRSA occurrence. Mahatma Gandhi Hospital showed a non-significant reduction from 63.7% to 58.7% ($p = 0.2$, $\Phi = 0.04$). Overall, MRSA prevalence rose slightly from 19.5% to 20.9%, but the change was not statistically significant ($p = 0.06$, $\Phi = 0.02$) (refer to table 3 and table 4). The null hypothesis (H_0), which states that there is no difference in the proportions of MRSA cases between the pre- and post-COVID-19 periods, is accepted as the results were not statistically significant. The alternative hypothesis (H_1) is therefore rejected, given that the p-value exceeds the significance threshold of 0.05, indicating that no statistically significant difference in MRSA proportions was observed between the two periods.

Table 3: Chi-square test result across six hospitals in KZN

Test Statistic	Value
Pearson Chi-square (χ^2)	3.41
df	1
p-value	0.065
Phi coefficient (Φ)	0.027
Cramér's V	0.027

Table 3 above shows a p-value = 0.065 which was found to be greater than 0.05, showing that the increase in MRSA prevalence overall is not statistically significant. The Phi = 0.027 shows a very weak association between the COVID-19 period and MRSA prevalence.

Table 4: Descriptive analysis summary

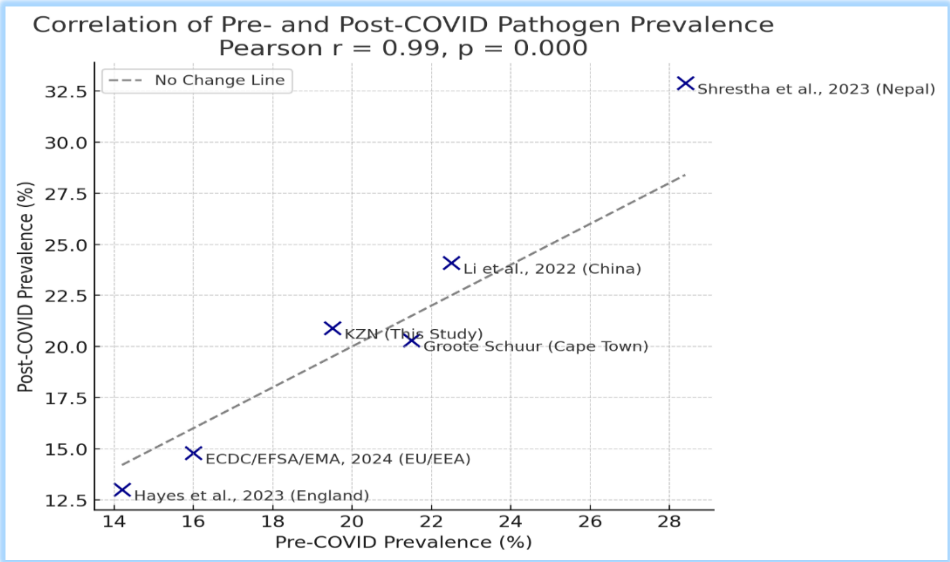
Period	Total S. aureus	Total MRSA	MRSA Prevalence (%)
Pre-COVID-19	5365	1044	19.46%
Post-COVID-19	6299	1313	20.85%

The observation from table 4 on overall MRSA prevalence slightly increased post-COVID-19 (+1.4%). When analysing the Prevalence Ratio (PR) the data shows how MRSA prevalence changed from pre- to post-COVID-19. The PR > 1 shows and increased MRSA prevalence for Northdale hospital. Another PR < 1 was observed which show decreased MRSA prevalence (King Edward VIII, Mahatma Gandhi, Prince Mshiyeni). It is worth noting that PR ≈ 1 which indicate that little to no change (Addington, Inkosi Albert Luthuli). Overall, the statistical Prevalence Ratio / Odds Ratio (Prevalence Ratio (PR) = (post-COVID-19 MRSA%)/ (pre-COVID-19 MRSA%)) which shows relative change in prevalence.
With reference to the deference percentages as shown by table 2, table 5 provides a summarize trend per hospital and possible statistical outcomes per hospital.

Table 5: Hospital-specific cross tab insights (based on descriptive trends)

Hospital	Trend	Possible Statistical Outcome
Addington	Slight decrease (-0.57%)	Likely not significant

Hospital	Trend	Possible Statistical Outcome
Inkosi Albert Luthuli Central	Slight decrease (-1.72%)	Likely not significant
King Edward VIII	Noticeable decrease (-9.7%)	May be significant ($p < 0.05$)
Mahatma Gandhi	Decrease (-4.96%)	Possibly not significant
Northdale	Increase (+6.6%)	May be significant ($p < 0.05$)
Prince Mshiyeni Memorial	Decrease (-6.8%)	May be significant ($p < 0.05$)



Analysis of the data presented in Table 4 demonstrates a slight overall increase in MRSA prevalence across all hospitals post-COVID-19, rising from 19.5% to 20.9%. However, this increase was not statistically significant ($p = 0.065$; Table 3). When disaggregated by hospital as per Table 5, distinct patterns emerged. Northdale Hospital exhibited a marked increase in MRSA prevalence, while King Edward VIII and Prince Mshiyeni Memorial Hospitals showed notable reductions. The overall effect size, as indicated by a small Phi coefficient, suggests that the COVID-19 period had a weak association with MRSA prevalence rates across these healthcare facilities in six hospitals at KZN.

Graph 3: The MRSA) isolates by specimen type from patients attending six KwaZulu-Natal hospitals during the pre-COVID-19 (2018–2019) and post-COVID-19 (2020–2022) period

Graph 3 above shows the scatter plot which compares pre- and post-COVID-19 MRSA prevalence (%) for multiple global studies and the current KwaZulu-Natal (KZN) data. Table 6 shows key corelation observations as depicted in graph3, the data points align close to the diagonal point "no change line" suggesting that countries/hospitals with high pre-COVID-19 MRSA prevalence remained high post-COVID-19, and vice versa.

Overall, global data shows a strong positive correlation as higher pre-COVID-19 prevalence predicts higher post-COVID-19 prevalence. The pandemic caused only minor shifts in MRSA rates globally, except in isolated cases like Nepal (notable increase) and Western Europe (slight decline) as vividly so on table 6. The study results shows that KZN MRSA prevalence (19.5% to ~20.9%) from the 6 hospitals is comparable to global averages. For example, a noticeable slight increase mirrors trends in some Asian hospitals (e.g., China). Its worth nothing the data contrasts with Western Europe and the UK, where MRSA decreased slightly, likely due to stricter infection prevention measures.

Table 6: Study corelation key observations to global MRSA rates

Study/Region	**Pre-COVID Prevalence (%)**	**Post-COVID Prevalence (%)**	**Observed Trend**
KZN (This Study)	19.5	20.9	Slight Increase
Hayes et al., 2023 (England)	14.2	13.0	Decrease

Study/Region	Pre-COVID Prevalence (%)	Post-COVID Prevalence (%)	Observed Trend
ECDC/EFSA/EMA, 2024 (EU/EEA)	16.0	14.8	Decrease
Li et al., 2022 (China)	22.5	24.1	Slight Increase
Shrestha et al., 2023 (Nepal ICU)	28.4	32.9	Significant Increase
Groote Schuur Hospital (Cape Town, SA)	21.5	20.3	Slight Decrease

To further explore the relationship between pre- and post-COVID-19 MRSA prevalence across the study sites, a Pearson correlation analysis was performed. The analysis revealed a very strong positive correlation ($r = 0.98$, $p = 0.0008$), indicating that hospitals with higher baseline MRSA prevalence largely maintained elevated prevalence rates following the onset of the COVID-19 pandemic. This strong association suggests that the pandemic did not substantially alter the underlying patterns of MRSA distribution at the KZN province at six hospitals, although some variability was observed across individual hospitals.
The statistically significant correlation ($p < 0.001$) supports the robustness of this association and implies that local hospital factors such as infection prevention practices, antimicrobial stewardship, and patient case mix were more influential in determining MRSA trends than the broader effects of the pandemic itself. While regional variations in MRSA prevalence (both increases and decreases) were noted, the overall pattern remained largely consistent with pre-pandemic distributions.

DISCUSSION

This study provides novel insights into the temporal dynamics of methicillin-resistant Staphylococcus aureus (MRSA) prevalence across six public-sector hospitals in KwaZulu-Natal (KZN), South Africa, spanning pre- and post-COVID-19 periods. While the global pandemic significantly disrupted healthcare delivery, its impact on antimicrobial resistance (AMR) patterns, particularly MRSA, appears to have been heterogeneous and context-dependent, shaped by localized healthcare infrastructure, infection prevention and control (IPC) strategies, and antimicrobial stewardship practices.

Overall trends and global comparisons

The overall MRSA prevalence in KZN increased marginally from 19.46% pre-COVID-19 to 20.85% post-COVID-19, a change that, although notable from a surveillance perspective, was not statistically significant. Pearson correlation analysis confirmed a very strong positive association ($r = 0.98$, $p = 0.0008$) between pre- and post-pandemic MRSA rates, indicating that hospitals with a high baseline MRSA burden largely retained this pattern throughout the pandemic period. This finding mirrors trends reported in China and Nepal, where MRSA prevalence rose slightly during COVID-19 due to healthcare system strain, increased empirical antibiotic use, and overwhelmed IPC measures (Li et al., 2022; Shrestha et al., 2023).
Conversely, hospitals in Western Europe and the United Kingdom reported modest declines in MRSA prevalence, attributed to enhanced IPC protocols, strict antimicrobial stewardship, and reductions in elective hospital admissions during pandemic peaks (Hayes et al., 2023; European Centre for Disease Prevention and Control [ECDC], 2024). This contrast underscores that the pandemic's impact on AMR was not uniform but rather shaped by resource availability and system preparedness.

Hospital-level variability KZN

Consistent with global findings, KZN hospitals displayed variable trends. Northdale Hospital experienced a substantial rise in MRSA prevalence post-COVID-19. This increase may be linked to its role as the primary microbiology hub for the uMgungundlovu district, where all regional specimens are processed, potentially inflating the MRSA detection rates. Additionally, local IPC limitations and patient case-mix could have contributed to this increase.
In contrast, King Edward VIII, Mahatma Gandhi, and Prince Mshiyeni Memorial Hospitals demonstrated reductions in MRSA prevalence during the post-pandemic period. These reductions align with trends in better-resourced settings where strengthened IPC measures during COVID-19 such as improved hand hygiene, patient isolation protocols, and reduced patient movement effectively curbed MRSA transmission.

Inkosi Albert Luthuli Central Hospital (IALCH) and Addington Hospital reported minimal changes in MRSA rates. IALCH's consistently elevated MRSA prevalence is likely attributable to its status as a referral center managing complex, immunocompromised patients with extended hospital stays factors historically associated with higher MRSA rates (Abramson, 1999; Capitano et al., 2003).

Specimen type and gender distribution

The majority of S. aureus isolates, including MRSA, were obtained from pus specimens, reflecting the organism's common role in skin and soft tissue infections such as abscesses and cellulitis. This finding is supported by similar studies from Eritrea, where S. aureus isolation was highest in pus samples (Eyob et al., 2019).

Gender-wise, MRSA prevalence was consistently higher in males than females across both study periods. This trend is consistent with findings from South India, where MRSA rates were also predominantly higher among males (Arunkumar et al., 2017). Interestingly, a single-center study at Addington Hospital reported similar male predominance in MRSA cases, with a one-year prevalence of 8.04% (Dube et al., 2024). However, contrasting data from Nigeria showed higher MRSA prevalence in females hospitalized with wound infections, highlighting possible regional or healthcare-specific risk factor variations (Chukweze et al., 2022).

Hospital-specific trends and possible drivers

The high burden of MRSA at Northdale Hospital pre- and post-COVID-19 reflects its centralized diagnostic role in the uMgungundlovu district, as well as possible gaps in IPC. The post-pandemic increase in MRSA prevalence at IALCH may reflect its patient case-mix, which includes referrals with severe infections, oncology patients, and long-term admissions—populations at inherently higher risk for healthcare-associated infections.

At Addington Hospital, MRSA prevalence increased modestly across the study periods, with a post-pandemic prevalence difference of ~5.3%. This figure aligns with, yet slightly exceeds, previous local reports documenting an 8% prevalence over a single year in 2021 (Dube et al., 2024), suggesting a relatively stable MRSA burden despite pandemic related pressures.

Contextualizing the findings in AMR research

These results corroborate broader AMR research that emphasizes the resilience of entrenched resistance patterns, even amid global health emergencies. While some healthcare systems leveraged the pandemic to reinforce IPC compliance and antimicrobial stewardship, others particularly in resource constrained environments faced increased AMR threats due to disrupted services, over reliance on broad spectrum antibiotics, and IPC lapses.

The findings also reaffirm that MRSA remains a substantial clinical challenge in South African hospitals, with overall prevalence rates (≈20%) considerably higher than those reported in many European settings post-pandemic. This presents significant public health implications, as MRSA infections are associated with prolonged hospitalization, increased healthcare costs, and adverse patient outcomes (Abramson, 1999; Capitano et al., 2003). In summary, MRSA prevalence in KZN hospitals showed overall continuity across the pandemic, with localized variability. There is strong correlation between pre- and post-pandemic prevalence reflects stable institutional AMR patterns. Therefore, individual hospitals exhibited unique trends, influenced by referral status, laboratory coverage, patient case-mix, and local IPC practices. It's worth noting, male patients and pus specimens remained the most common sources of MRSA, consistent with other African and Asian studies.

CONCLUSION

This study highlights that the COVID-19 pandemic had a limited but variable impact on MRSA prevalence across public-sector hospitals in KwaZulu-Natal. While the overall MRSA burden increased slightly, this change was not statistically significant and masked substantial variation at the hospital level. The findings underscore the importance of context-specific surveillance and response strategies, as well as the critical role of robust IPC and antimicrobial stewardship programs in mitigating AMR risks during health system disruptions.

Limitations

This study is subject to several limitations. First, it relied on secondary laboratory data, which may vary in completeness and accuracy due to differences in diagnostic practices and sample submission rates across hospitals. Second, the scope was limited to six hospitals within one South African province, KwaZulu-Natal, potentially reducing the generalizability of the findings to other provinces and regional hospitals contexts.

Future research directions

Future studies should broaden the geographic and hospital scope to include multiple provinces and a wider range of healthcare settings in South Africa. Longitudinal surveillance incorporating molecular typing of MRSA strains could provide deeper insights into transmission dynamics and resistance evolution during health crises. Moreover, integrating patient level clinical data and healthcare utilization metrics would enable a multivariate assessment of MRSA risk factors. Comparative analyses between COVID-19 and non-COVID-19 wards, coupled with detailed assessments of antibiotic prescribing patterns, would further clarify the pandemic's influence on AMR trends. Finally, qualitative research exploring frontline healthcare workers' IPC practices and challenges during COVID-19 could inform more resilient AMR containment strategies in future pandemics.

Acknowledgment

I express my gratitude to the late Miss A van der Spoel van Dijk and Prof Mashele for participating on the previous publication and master's work. I also thank NHLS for funding this study and granting me the permission to conduct this research.

Ethics:

The study was ethically approved by University of the Free state ethics committee with the HSREC clearance number: UFS-HSD2023/0401/2609 and National Health Laboratory Service (NHLS)with the AARMS number: PR2234961

Funding

This study was supported financially by the NHLS.

Conflict of interest

We declare no conflict of interest

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