# The effect of COVID-19 lockdown periods and societal restrictions on blood product usage in adult trauma patients: A retrospective observational study

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**Background.** Blood products, though potentially lifesaving, are a scarce and costly resource. Trauma injuries, which contribute to the demand for these resources, increase in proportion to alcohol consumption. South Africa's COVID-19 lockdown measures included a ban on alcohol sales and curfews.
**Objective.** To investigate the effect of these societal measures on blood product usage.
**Methods.** We retrospectively compared medical patient data from the South African National Blood Service database of red cell concentrate (RCC) usage in four disciplines during the COVID-19 period with data from the 3 years preceding the pandemic. We also examined trauma case patterns using an institutional database from the Harry Gwala Regional Hospital (HGRH) Emergency Department during the same periods.
**Results.** In total, 16 922 RCCs at HGRH and 528 734 RCCs in KwaZulu-Natal were issued across the four disciplines, from March 2017 - March 2021. RCC usage significantly decreased among trauma patients at institutional and provincial levels during the COVID-19 period (provincial pre-lockdown mean 10.99 units per day; SD 6.89, 95% CI 10.63 - 11.35 v. lockdown 7.46 units per day; SD 5.42, 95% CI 6.14 - 8.79; $p<0.01$). Further, RCC usage significantly increased during the weekend immediately following the lifting of the first alcohol ban, along with a significant decrease in the number of trauma patients seen during hard lockdown periods.
**Conclusions.** Societal restrictions, including curfews and banning alcohol consumption, decreased the use of RCCs in trauma patients. Government policies aimed at reducing alcohol-related traumatic injuries would likely have a significant impact on RCC usage.

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Blood products are a life-saving, but costly and limited resource, especially in resource-limited environments.[1] Trauma-related injuries place a significant burden on healthcare systems, impacting key hospital metrics, such as waiting times, bed utilisation, expenditure and theatre availability.[2] The COVID-19 pandemic led to worldwide lockdowns with restrictions on travel, socialisation and the sale of alcohol.[2-5] This unique set of societal restrictions led to a demonstrable reduction in trauma cases internationally,[6,7] and a similar pattern was observed in South Africa (SA), with a 50% decrease in caseloads.[2,8,9] This unique set of societal restrictions led to a demonstrable reduction in trauma cases internationally,[6,7] and a similar pattern was observed in SA, with a 50% decrease in caseloads.[2,8,9] Lockdown periods resulted in a dramatic reduction in trauma patients in two SA settings, but with a return to pre-lockdown trauma caseloads immediately after the lockdown was lifted.[10,11] There also appeared to be a significant increase in trauma cases following the relaxation of alcohol bans.[12] The high incidences of trauma in SA result in costly blood product usage.[13] A study from a single tertiary hospital in the Western Cape demonstrated a significant decrease in blood product usage during the 2020 lockdown period.[14]

The impact of societal restrictions and alcohol bans on blood product usage has not been quantified in SA. We aimed to address this gap by comparing blood product usage in adult trauma cases at a provincial level between pre-lockdown and hard lockdown periods, in the hope of informing and supporting future public health policies whose goal is to reduce trauma

through more acceptable societal measures. We hypothesised that there would be a significant reduction in the usage of these products during the periods of lockdown when compared to pre-lockdown periods.

## Methods

### Study design

This retrospective cohort study used records from two databases spanning a 4-year period (March 2017 - March 2021). We used the South African National Blood Service (SANBS) database for red cell concentrate (RCC) usage in Harry Gwala Regional Hospital (HGRH) and KwaZulu-Natal (KZN). HGRH is a busy SA regional hospital with a traditionally high trauma patient burden.[15,16] RCC was selected because it is the most commonly used blood product and was expected to provide the clearest signal. We measured RCC *issued* by SANBS, as data for units *transfused* was not available. Classification of attending discipline was defined by the clinician requesting blood on the SANBS request form. The hard lockdown levels 4 and 5 consisted of 'drastic measures to contain the spread of the virus' and had 'extreme precautions to limit community transmission and outbreaks'.[17] The first restriction on alcohol sales occurred for the same period as this hard lockdown period (levels 4 and 5: 27 March - 1 June 2020). The second and third alcohol bans occurred during lower levels of lockdown (12 July - 17 August 2020, and 28 December 2020 - 1 February 2021).

The primary outcome was the number of RCC units per day for trauma cases at a provincial level between pre- and hard lockdown periods. Secondary outcomes included a comparison of institutional and provincial RCC usage among patients in the trauma, general surgery, obstetrics and gynaecology and internal medicine units during lockdown periods, where alcohol sale restrictions were implemented v. similar periods in the preceding three years when these measures were not in place. Finally, we described the trauma patient caseload by levels of urgency seen at HGRH to assess differences in case types between lockdown periods and non-lockdown periods. This data was acquired from an institutional database administered by the Emergency Department at HGRH.

### Statistical analysis

Data were exported from databases to an Excel spreadsheet (Microsoft Corporation, USA) on a password-protected computer. The data were then entered into a statistical analysis program (StataCorp, USA). Descriptive statistics were used for categorical variables and data are presented as frequency and percentages. Continuous data are presented as mean and standard deviation (SD) or median and interquartile range (IQR). The frequency distribution of the estimated monthly usage was examined for normality. Changes in admission data were also examined, and blood usage was adjusted for any changes in admission patterns. The monthly usage was compared between the pre-lockdown and lockdown periods using a t-test or Mann-Whitney *U*-test. The primary outcome was the number of RCCs used in KZN during the lockdown v. pre-lockdown periods. The secondary outcomes included (i) the number of RCCs used and the number of trauma patients seen in KZN immediately after hard lockdown levels were lifted and (ii) the number of RCCs used by various medical specialities at HGRH during the lockdown period, compared with the preceding years without lockdown.

### Ethical considerations

Approval for this study was obtained from the University of KwaZulu-Natal Biomedical Research Ethics Committee (BREC/00003251/2021), the SANBS Health Research Ethics Committee (HREC 2021/-0583) and the Provincial Department of Health (KZ_202112_001). Patient consent was not required. Data from the HGRH institutional database had obtained class approval (BCA207/09).

## Results

Data collection occurred retrospectively over the 4-year period between March 2017 and March 2021. We analysed 16 940 RCC units from HGRH and 511 812 RCC units from KZN. At HGRH, a total of 652 units of RCC were used by the trauma department, 5 925 RCC units by general surgery, 4 596 RCC units by obstetrics and gynaecology, and 5 767 RCC units by internal medicine. At a provincial level, the corresponding figures were 16 164 (trauma), 104 009 (general surgery), 136 846 (obstetrics and gynaecology) and 254 793 units of RCC by internal medicine. The mean number of units per discipline transfused per day during pre-lockdown v. lockdown periods levels 4 and 5 are shown in Table 1 for KZN. For the primary outcome (the mean number of RCC units per day for trauma at a provincial level), there was a significant reduction in units (pre-lockdown mean 10.99; SD 6.89, 95% CI 10.63 - 11.35 v. lockdown mean 7.46; SD 5.42, 95% CI 6.14 - 8.79; $p<0.01$).

A similar comparison at an institutional level was performed. Specifically, we analysed the mean number of units per discipline transfused per day in pre-lockdown v. lockdown periods at HGRH; only trauma cases showed a significant reduction in RCC units used (mean [SD] pre-lockdown 0.45 (SD 1.09), 95% CI 0.39 - 0.51 v. 0.16 (0.62), 95% CI 0.01 - 0.31; $p=0.03$).

We conducted a similar analysis, in which pre-lockdown levels were compared with lockdown levels 1 - 3, which ranged from 'restrictions on many activities at workplaces and socially, physical distancing and restrictions on leisure', to 'most normal activity can resume with precautions'.[17] Trauma alone demonstrated a significant reduction in blood usage (pre-lockdown 10.2; SD 6.5, 95% CI 9.9 - 10.6 v. 13.1; SD 7.7, 95% CI 12.3 - 14.0; $p<0.01$).

We further analysed the effects caused by the lifting of the alcohol ban on trauma RCC usage at a provincial level. During the 10 weekends of the alcohol ban (30 days), the mean number of RCC units used in the trauma department per day was 7.8 (SD 6.08, 95% CI 5.53 - 10.07) v. 26 (SD 9.54, 95% CI 2.3 - 49.7) in the first weekend after lifting the ban ($p<0.01$). This is shown graphically in Fig. 1.

Caseloads seen in the emergency department by category of urgency are detailed in Table 2, in which pre-lockdown levels are compared with all lockdown levels (1 - 5). There were significant decreases in all case types. We performed a similar analysis for the 10 weekends of the alcohol ban v. the first weekend after the alcohol ban was lifted (Table 3), which confirmed a significant

increase in green, yellow and red-coded cases, following the lifting of the alcohol ban.

We also estimated potential cost savings for the difference in blood products used between provincial trauma and general surgery patients based on the results shown in Table 1. We used the mean daily difference in RCC usage to estimate annual differences and multiplied this by the cost of a single RCC unit. Based on the SANBS price list for state patients for 2023/2024,[18]

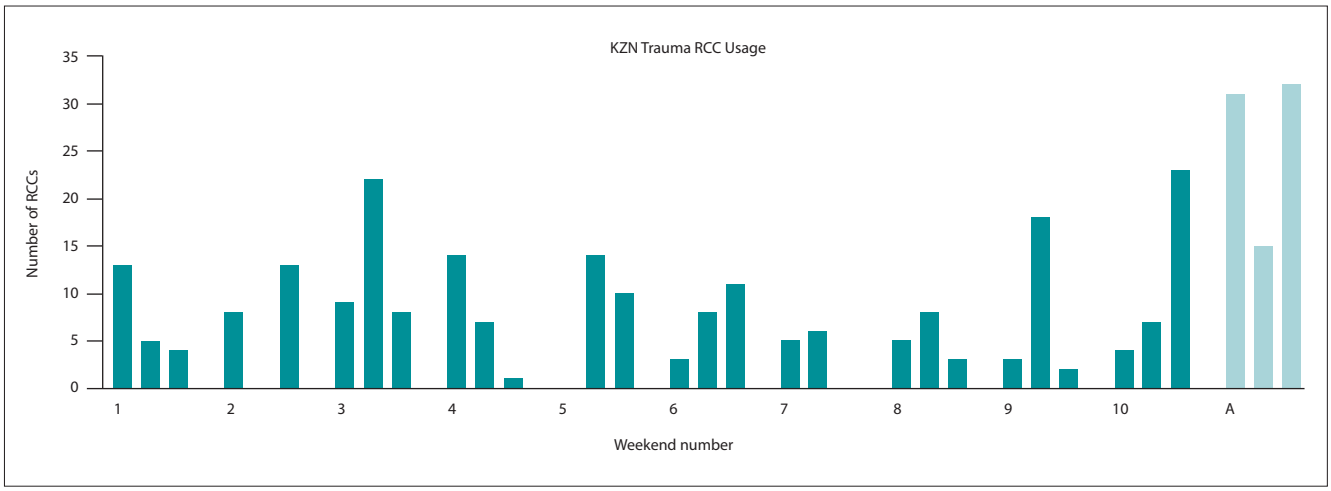


*Fig. 1. Red cell concentrate numbers over the 10 weekends of the alcohol ban versus the first weekend after the ban ended (A) in KwaZulu-Natal (KZN). RCCs = red cell concentrates; KZN = kwaZulu-Natal.*

**Table 1. The mean number of units per discipline transfused per day in pre-lockdown v. lockdown periods for KwaZulu-Natal**

| | Pre-lockdown (days = 1 425) | | | Lockdown levels 4 and 5 (days = 67) | | | *p*-value |
|---|---|---|---|---|---|---|---|
| | Mean | SD | CI | Mean | SD | CI | |
| Trauma | 10.99 | 6.89 | 10.63 - 11.35 | 7.46 | 5.42 | 6.14 - 8.79 | <0.01** |
| General surgery | 70.42 | 25.88 | 69.07 - 71.76 | 54.73 | 21.59 | 49.47 - 60.00 | <0.01** |
| Obstetrics and Gynaecology | 91.91 | 31.54 | 90.27 - 93.54 | 87.76 | 28.06 | 80.92 - 94.60 | 0.29 |
| Internal medicine | 171.84 | 63.50 | 168.55 - 175.14 | 147.98 | 59.95 | 133.35 - 162.59 | <0.01** |

**$P<0.01$
SD = standard deviation; CI = 95% confidence interval.

**Table 2. Emergency Department caseloads at Harry Gwala Regional Hospital in pre-lockdown periods v. all lockdown periods**

| | No lockdown (1 122 days) | | | Lockdown (370 days) | | | *p*-value |
|---|---|---|---|---|---|---|---|
| | Mean | SD | CI | Mean | SD | CI | |
| Green | 31.1 | 10.4 | 30.5 - 31.7 | 23.5 | 9.6 | 22.5 - 24.5 | <0.01** |
| Yellow | 12.6 | 6.8 | 12.2 - 13.0 | 8.8 | 4.7 | 8.3 - 9.3 | <0.01** |
| Orange | 1.8 | 1.8 | 1.7 - 1.9 | 1.4 | 1.4 | 1.2 - 1.5 | <0.01** |
| Red | 0.7 | 0.9 | 0.6 - 0.7 | 0.5 | 0.9 | 0.6 - 0.7 | <0.01** |

**$P<0.01$
SD = standard deviation; CI = 95% confidence interval.

**Table 3. Weekend Emergency Department caseloads at Harry Gwala Regional Hospital during the alcohol ban v. the first weekend after no alcohol ban**

| | Alcohol ban (30 days) | | | Alcohol ban lifted (3 days) | | | *p*-value |
|---|---|---|---|---|---|---|---|
| | Mean | SD | CI | Mean | SD | CI | |
| Green | 17.2 | 7.9 | 14.2 - 20.1 | 31.3 | 8.4 | 10.5 - 52.2 | <0.01** |
| Yellow | 8.1 | 4.0 | 6.6 - 9.6 | 15 | 4 | 5.1 - 24.9 | <0.01** |
| Orange | 0.6 | 0.8 | 0.3 - 0.9 | 1.3 | 1.2 | −1.5 - 4.2 | 0.16 |
| Red | 0.3 | 0.7 | 0.1 - 0.5 | 1.7 | 2.1 | −3.5 - 6.8 | 0.01* |

*$P<0.05$
**$P<0.01$
SD = standard deviation; CI = 95% confidence interval.

annual provincial savings for trauma patients would be ZAR3 065 673.51 and ZAR13 626 180.55 for general surgery patients. These figures exclude the costs of the administration set, crossmatch, after hours and emergency levies, and do not factor in other blood products that are often ordered with massive blood transfusions.

## Discussion

This study demonstrated a significant decrease in blood product usage for trauma patients at both institutional and provincial levels during the COVID-19 lockdown periods, driven by a reduction in caseload. These reductions may be attributed to a lack of access to healthcare as evidenced by similar reductions in transfusions in general surgery and internal medicine. However, when the lockdown level was relaxed to a lower level (lockdown 1 - 3), the benefits were observed just in the trauma group at a provincial level. Notwithstanding, the study confirmed that societal measures, such as alcohol bans and travel restrictions result not merely in a reduction in trauma cases, but also in blood transfusion requirements.

We aimed to isolate the alcohol effect by comparing the caseload and transfusion rates at the first weekend after the ban ended, with the rates recorded in the 10 preceding weekends. This analysis confirmed a significant increase in caseload and number of RCCs used, suggesting a relationship between alcohol usage and RCC usage (Fig. 1). The two individual days of highest usage both occurred on the weekend following the lifting of the alcohol ban.

RCC usage in obstetrics and gynaecology during lockdown periods 4 - 5 showed no differences from pre-lockdown levels. This finding is most likely due to conception occurring many months before lockdown, with a resultant normal demand for blood products despite hard lockdown measures being implemented. As such, obstetric caseloads would unlikely be affected by societal restrictions unless access to care was limited.

The reduction in trauma cases was seen at all lockdown levels, as confirmed by data published by Morris *et al*.[9] The number of RCC units used is directly proportional to the number of cases seen. International studies showed that 7% of trauma-related mortality is linked to alcohol consumption.[18] Alcohol use is known to have a significant impact on the burden of disease, particularly related to injury.[20,21] Data from the Western Cape Government suggests a 40 - 50% decrease in trauma burden during the lockdown periods and alcohol bans, with a subsequent 66% rise in trauma cases across health facilities immediately after the alcohol ban was lifted.[22] Our study supports these findings. Government initiatives to reduce alcohol-related harm should be considered, including those based on recommendations such as the SAFER initiative started by the World Health Organisation.[23]

We conducted a limited cost analysis based on the difference in mean RCC usage in trauma and general surgery patients, which demonstrated significant potential savings in healthcare expenditure. These figures represent an underestimation of savings, as the costs of the administration set, crossmatch and after-hours and emergency levies are not included. These costs depend on the time of day and differ in single-unit v. multiple-unit transfusions. We also did not factor in other blood products that are often ordered with massive blood transfusions. Reduced RCC usage is important in SA, where inadequate blood supply is common and a dwindling donor pool is required to make 3 500 donations to ensure adequate supply.[24]

### Limitations and strengths

The study reflects the trends of RCC usage and trauma cases at a single-centre regional hospital and in one province in SA. We were unable to access national data for comparison. Further studies would be useful to compare the above data to other regional hospitals and across the other provinces. The SANBS and HGRH databases did not subcategorise the blood product ordering into age groups. As such, the difference between adult and paediatric trauma blood ordering was not quantified. The SANBS data delineating trauma patients seen in the HGRH Emergency Department did not classify which patients were discharged from the ED and which were admitted. Blood products ordered directly by HGRH ED were not divided into surgical and non-surgical patients and thus were not analysed.

National data on blood product ordering would be valuable in quantifying national trends in blood product usage. It would be advantageous if a presumed, similar trend to the findings of our study could be proved. Future research should examine community-level measures aimed at reducing either the amount or the pattern of alcohol usage in South Africa, to decrease the societal impact of its use.

## Conclusion

The COVID-19 lockdown period and its restrictions resulted in unique socioeconomic, recreational and behavioural variations. This study compared the use of RCCs during the COVID-19 period with the preceding 3 years without lockdown and revealed a significant decrease in caseloads and the usage of RCCs among trauma patients at both a regional and provincial level in KZN. Specifically, alcohol bans appear to have significantly impacted these metrics. National advisory bodies, community improvement programmes and government structures could use this information to aid the development and implementation of policies aimed at decreasing the trauma burden and the associated high levels of blood product requirements in SA.

**Declaration.** None.

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**Author contributions.** All authors contributed to the study's conception and design. Material preparation and data collection were performed by AL. Statistical analysis was performed by DB. All authors read and approved the final manuscript.

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**Conflicts of interest.** The authors declare no conflict of interest.

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