



COST ANALYSIS AND EFFECT OF COVID-19 PANDEMIC ON THE PURCHASING PATTERNS OF MEDICAL GLOVES BY THE JORDANIAN ROYAL MEDICAL SERVICES.

Alaa Ahmad Alryalat;PH¹, Amani Habes Saleh Abu-Hdaib;PH¹, Rami Al-Lawama;PH¹, Reham Mohammad Al-Zaben ;PH¹, Halah Salem Abu Alghanam;PH¹.

¹Pharmacist, Royal Medical Services, Jordan.

Submitted on: 18.11.2024;

Revised on: 27.11.2024;

Accepted on: 30.11.2024

ABSTRACT

- 1. Introduction:** The COVID-19 epidemic has greatly disrupted healthcare systems worldwide, resulting in several challenges related to procuring vital medical supplies, particularly personal protective equipment (PPE) including medical gloves. Medical gloves are vital for hampering the transmission of infection in hospital settings, and providing adequate quantities became a primary concern for healthcare providers throughout the pandemic. The Jordanian Royal Medical Services (JRMS), responsible for delivering healthcare services to military troops, their families, and civilians, faced difficulties in ensuring a consistent supply of gloves during this period of time. The objective of this study is to examine the purchasing patterns and cost fluctuations of medical gloves by the JRMS from 2020 to 2023. The study will analyze this specific period, focusing on the peak of the pandemic, to gain a deeper understanding of how JRMS adjusted its procurement strategy in light of disruptions in the worldwide supply chain.
- 2. Objective:** The main objective of this study is to examine the patterns in the acquisition of medical gloves by the JRMS from 2020 to 2023, specifically investigating the influence of the COVID-19 pandemic on purchasing trends and expenditures. The study aims to achieve the following particular objectives: To identify and analyze the patterns in the procurement of various categories of medical gloves, analyzing the primary determinants that impacted variations in expenses and quantities throughout this timeframe, specifically during the pandemic, assessing the efficiency of the JRMS's procurement procedures in obtaining essential supplies during worldwide interruptions, and analyzing the lessons learned from the JRMS experience to guide future procurement practices and improve readiness for future emergencies.
- 3. Methodology:** The study will employ a quantitative retrospective methodology, utilizing procurement data acquired from the JRMS procurement department during the time frame of 2020 to 2023. The dataset comprises comprehensive information on the overall expenses and quantities of several categories of medical gloves, encompassing both sterile and non-sterile gloves of varying sizes. The analysis will be performed via Excel Spreadsheet and organized into three distinct phases: pre-pandemic, pandemic peak, and post-peak stabilization. The findings will be displayed in a tabular format, accompanied with an in-depth examination of cost and quantity patterns for each category of gloves. The findings derived from this research will enhance comprehension of the difficulties encountered by healthcare systems during crises and offer significant insights for future procurement planning and crisis management.

KEYWORDS: Jordanian Royal Medical Services (JRMS), medical gloves, procurement, cost analysis, purchasing patterns, COVID-19 pandemic, sterile gloves, non-sterile gloves, healthcare supply chain, personal protective equipment (PPE), crisis management, Jordan.

Corresponding Author: Alaa Ahmad Alryalat

E-mail: Alaa_ryalat@yahoo.com,

Mobile No: 00962796561339

Indian Research Journal of Pharmacy and Science; 41(2024)3168—3175;

Journal Home Page: <https://www.irjps.in>

1. INTRODUCTION:

The acquisition of medical supplies, especially personal protective equipment (PPE), emerged as a pivotal concern for healthcare systems globally during the COVID-19 pandemic^[1,2]. Medical gloves are essential personal protective equipment that protects healthcare personnel and patients from infection^[3]. The Jordanian Royal Medical Services (JRMS), a principal healthcare provider in Jordan^[4], encountered significant difficulty in maintaining a steady supply of medical gloves during the pandemic. The purpose of this research is to examine the purchasing trends and pricing fluctuations of medical gloves by the JRMS from 2020 to 2023, concentrating on both sterile and non-sterile gloves in various sizes.

The pandemic's effect on global supply chains resulted in significant shortages of critical medical supplies, causing price volatility and inconsistent availability. The demand for medical gloves increased significantly as healthcare providers enhanced infection control protocols^[5,6]. As a result, procurement organizations, such as the JRMS, were compelled to swiftly adjust to evolving market conditions. Comprehending how the JRMS addressed these problems yields significant insights into the efficacy of their procurement strategies and the wider ramifications for healthcare systems in crisis scenarios.

Medical gloves are essential elements of infection control protocols in both surgical and non-surgical environments. They are intended to safeguard healthcare personnel and patients from the spread of infectious pathogens. Sterile gloves are generally employed in surgical operations to avert contamination of the surgical site, whereas non-sterile gloves are utilized in regular examinations and procedures to safeguard against cross-contamination^[7,8]. The acquisition of these gloves must reconcile cost, quantity, and quality to guarantee that healthcare professionals are sufficiently protected without depleting scarce resources.

The JRMS, a prominent healthcare provider in Jordan, manages a network of hospitals and clinics catering to military personnel, their families, and civilians^[4]. The organization is tasked with ensuring that these facilities are supplied with essential medical resources, such as gloves, to deliver safe and effective care. The procurement process for medical gloves during the pandemic undoubtedly entailed complicated decision-making, shaped by circumstances including worldwide

supply constraints, price fluctuations, and evolving clinical requirements.

This study examines the purchasing trends of several types of medical gloves over four-year duration, utilizing data on both price and quantity. The analysis seeks to identify trends and patterns in the procurement process, emphasizing the challenges and methods utilized by the JRMS during this period. This study aims to enhance the comprehension of how healthcare systems might improve their preparedness and response to future emergencies by analyzing these tendencies.

This study addresses the following key research questions:

1. What alterations occurred in the JRMS's procurement trends for medical gloves from 2020 to 2023?
2. What were the primary factors affecting the variations in cost and quantity of gloves acquired by the JRMS throughout this period?
3. How did the JRMS reconcile the necessity for adequate glove supplies with the limitations imposed by a fluctuating market?

The study seeks to deliver meaningful information for healthcare procurement strategies, specifically regarding emergency readiness and response, by addressing these concerns. The results of this study may guide future procurement policies and practices, enhancing healthcare systems' preparedness for analogous crises.

2. METHOD:

This study constitutes a retrospective examination of medical glove purchasing data from the JRMS, derived from procurement department records spanning four years (2020-2023). The data comprises two tables: one detailing the total cost of various glove types and sizes for each year, and the other indicating the total quantity purchased. The glove categories comprise sterile and non-sterile disposable surgical and examination gloves, available in sizes from 6.5" to large. The analysis focused on identifying trends in purchasing patterns, encompassing variations in quantity and cost over time. No supplementary data sources were utilized, and all references are derived from verified governmental data.

The analysis will be performed via Excel Spreadsheet and organized into three distinct phases: pre-pandemic, pandemic peak, and post-peak stabilization. The findings will be displayed in a tabular format, accompanied with an in-depth

examination of cost and quantity patterns for each category of gloves. The findings derived from this research will enhance comprehension of the difficulties encountered by healthcare systems

during crises and offer significant insights for future procurement planning and crisis management (Tables 1, 2).

Table 1: The estimated cost of various types of gloves per year

Total Cost	2020	2021	2022	2023
Sterile, Powdered Disposable Surgical Gloves, Size 6.5"	54,776	0	100,643	33,548
Sterile, Powdered Disposable Surgical Gloves, Size 7"	140,155	0	252,277	84,092
Sterile, Powdered Disposable Surgical Gloves, Size 7.5"	36,360	0	284,483	94,828
Sterile, Powdered Disposable Surgical Gloves, Size 8"	40,811	0	155,660	51,887
Sterile, Powdered Disposable Surgical Gloves, Size 8.5"	14,876	0	19,323	6,441
Sterile, Un-powdered Disposable Surgical Gloves, Size 6.5"	509	0	2,576	0
Sterile, Un-powdered Disposable Surgical Gloves, Size 7.0"	8,350	75	7,361	0
Sterile, Un-powdered Disposable Surgical Gloves, Size 7.5"	8,584	0	7,361	0
Sterile, Un-powdered Disposable Surgical Gloves, Size 8.0"	717	0	2,945	0
Non-Sterile, Powdered Disposable examination Gloves, Size Large	444,055	246,193	738,578	259,860
Non-Sterile, Powdered Disposable examination Gloves, Size Medium	512,943	895,725	1,166,175	303,170
Non-Sterile, Powdered Disposable examination Gloves, Size Small	41,102	12,958	38,873	21,655

Table 2: Total quantity of used gloves per year

Total Quantity	2020	2021	2022	2023
Sterile, Powdered Disposable Surgical Gloves, Size 6.5"	468,000	0	675,000	225,000
Sterile, Powdered Disposable Surgical Gloves, Size 7"	1,168,800	0	1,692,000	564,000
Sterile, Powdered Disposable Surgical Gloves, Size 7.5"	1,321,200	0	1,908,000	636,000
Sterile, Powdered Disposable Surgical Gloves, Size 8"	350,000	0	1,044,000	348,000
Sterile, Powdered Disposable Surgical Gloves, Size 8.5"	88,710	0	129,600	43,200
Sterile, Un-powdered Disposable Surgical Gloves, Size 6.5"	4,800	0	16,800	0
Sterile, Un-powdered Disposable Surgical Gloves, Size 7.0"	50,778	500	48,000	0
Sterile, Un-powdered Disposable Surgical Gloves, Size 7.5"	52,545	200	48,000	0
Sterile, Un-powdered Disposable Surgical Gloves, Size 8.0"	5,850	250	19,200	0
Non-Sterile, Powdered Disposable examination Gloves, Size Large	15,625,000	4,750,000	14,250,000	15,000,000
Non-Sterile, Powdered Disposable examination Gloves, Size Medium	17,265,000	14,742,300	22,500,000	17,500,000
Non-Sterile, Powdered Disposable examination Gloves, Size Small	1,520,000	250,000	750,000	1,250,000

3. RESULTS:

This results section offers a comprehensive analysis of the purchasing patterns and cost dynamics of medical gloves by the Jordanian Royal Medical Services (JRMS) from 2020 to 2023. The data encompasses total costs and quantities for diverse types and sizes of gloves, facilitating a thorough examination of trends throughout this timeframe.

3.1 Cost Analysis

The cost data reveals considerable variations in the JRMS's expenditure on medical gloves, which may be subdivided into three distinct phases: pre-pandemic (2020), pandemic peak (2022), and post-peak stabilization (2023).

2020: Pre-Pandemic Baseline

The year 2020 establishes a benchmark for analyzing JRMS's standard glove procurement trends prior to the comprehensive effects of COVID-19. During this timeframe, costs remained relatively moderate across all glove categories. For instance, the total expenditure for Sterile, Powdered Disposable Surgical Gloves (Size 7") amounted to \$140,155.1, while the cost for Non-Sterile, Powdered Disposable Examination Gloves (Size Medium) was \$512,943.4. These statistics indicate that JRMS sustained a consistent procurement of gloves, most likely in anticipation of typical demand for surgical and examination procedures.

2021: Procurement Gap

The data reveals an absence of recorded costs for any glove types in 2021. This lack of information may suggest various scenarios, including the possibility that the JRMS depended on stockpiles accumulated in 2020, particularly if procurement was hindered by global supply chain disruptions.

This gap necessitates further examination, as it signifies a crucial period during the pandemic when there was a heightened global demand for medical supplies.

2022: Pandemic Peak

In 2022, there was a substantial rise in expenditures on medical gloves across all categories, driven by the increased demand during the pandemic's peak. For instance, the price of Sterile, Powdered Disposable Surgical Gloves (Size 7") increased to \$252,277.2, while Non-Sterile, Powdered Disposable Examination Gloves (Size Medium) reached \$1,166,175. This notable surge signifies the global urgency for PPE, resulting in price inflation and augmented procurement volumes. The JRMS, similar to numerous healthcare providers, likely encountered supply shortages and incurred elevated costs to obtain essential supplies^[9,10]. The heightened expenses also reflect the JRMS's adaptation to the surging demand for protective equipment to ensure the safety of healthcare personnel during a period of increased risk.

2023: Post-Peak Stabilization

As of 2023, the price of gloves has apparently stabilized, although at a higher rate than pre-pandemic levels. For example, the price of Sterile, Powdered Disposable Surgical Gloves (Size 7") fell to \$84,092.4, while Non-Sterile, Powdered Disposable Examination Gloves (Size Medium) decreased to \$303,170. This stabilization indicates that, despite sustained demand exceeding pre-pandemic figures, market conditions have improved, with supply chains becoming more robust and prices normalizing^[6,11]. The decline in costs relative to 2022 may also signify more strategic procurement approaches by the JRMS, potentially involving long-term contracts or leveraging enhanced global supply availability (Figure 1).

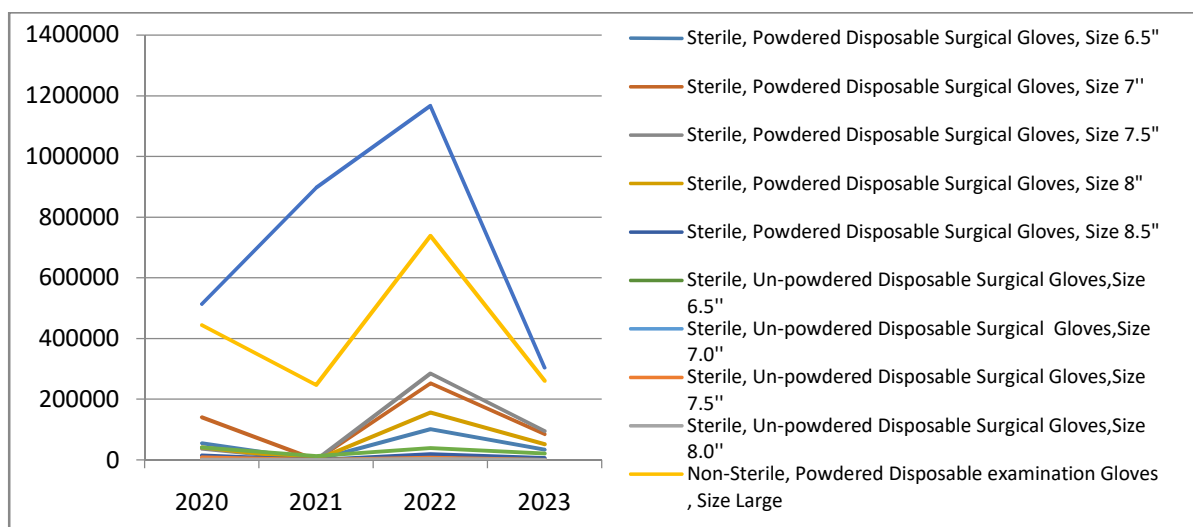


Figure 1: The estimated prices of gloves following the peak of COVID-19

3.2 Quantity Analysis

The quantitative data further substantiates the cost study, demonstrating how the JRMS modified their procurement volumes in reaction to the changing pandemic circumstances.

2020: Pre-Pandemic Quantity Levels

In 2020, JRMS retained significant stocks of medical gloves, indicative of standard healthcare requirements. Specifically, 11,688,000 Sterile, Powdered Disposable Surgical Gloves (Size 7") were acquired, alongside 17,265,000 Non-Sterile, Powdered Disposable Examination Gloves (Size Medium). These quantities correspond with the moderate prices prevalent during this timeframe, suggesting that JRMS was equipped for conventional healthcare needs.

2021: Quantity Data Gap

The quantity data for 2021 corresponds with the cost data, indicating no documented purchases for the majority of glove types. This suggests a potential procurement gap, implying that JRMS may have depended on existing inventory or encountered procurement difficulties.

2022: Surge in Quantity

In 2022, there was a notable escalation in glove quantities, paralleling the increase in costs. For example, JRMS acquired 16,920,000 Sterile, Powdered Disposable Surgical Gloves (Size 7") and 22,500,000 Non-Sterile, Powdered Disposable Examination Gloves (Size Medium). This substantial rise in quantities reflects the heightened demand for gloves during the pandemic's peak. JRMS likely had to considerably increase its procurement to satisfy the requirements of its healthcare facilities during this crisis.

2023: Post-Peak Quantity Levels

By 2023, the procurement quantities by JRMS stabilized. Specifically, 564,000 Sterile, Powdered Disposable Surgical Gloves (Size 7") and 17,500,000 Non-Sterile, Powdered Disposable Examination Gloves (Size Medium) were acquired. This reduction in quantity, although remaining above pre-pandemic levels, indicates the stabilization of healthcare requirements as the pandemic's effects diminished. JRMS seems to have modified its procurement strategy to correspond with the diminished yet still heightened demand (Figure 2).

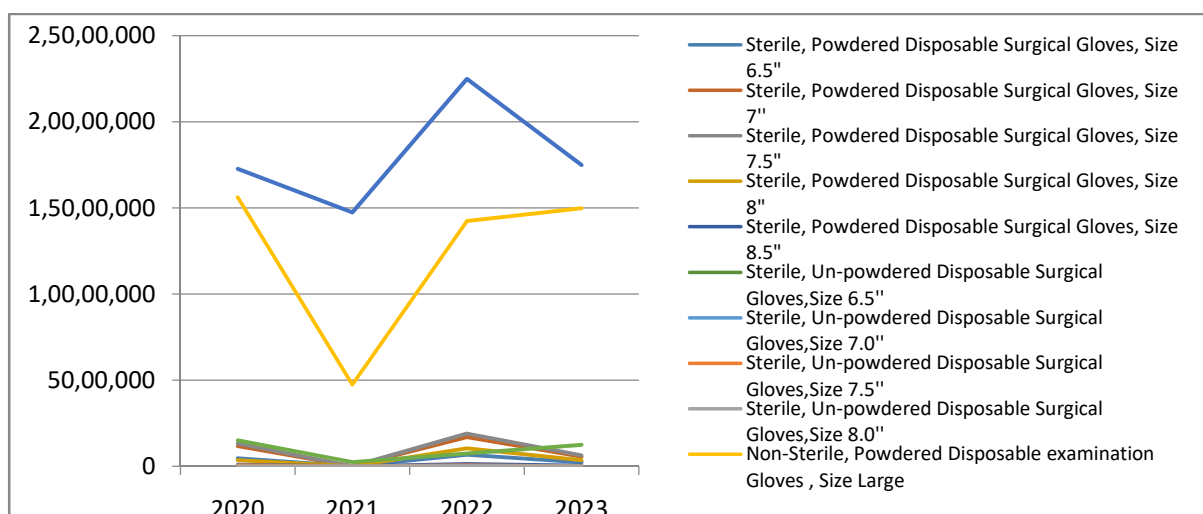


Figure 2: The estimated quantities of gloves (stabilized following the peak of COVID-19)

3.3 Detailed Analysis by Glove Type

A comprehensive study of each glove type is presented below to enhance understanding of the data.

Sterile, Powdered Disposable Surgical Gloves (Sizes 6.5" to 8.5")

These gloves were primarily utilized for surgical procedures, where sterility is critical. The data indicates that the JRMS initially sustained consistent procurement levels in 2020, with costs ranging from \$14,875.6 for Size 8.5" to \$54,775.8 for Size 6.5". The lack of data in 2021 is particularly noteworthy for these glove types, as it

implies a dependence on existing inventories or potential disruptions in surgical services. In 2022, procurement costs increased across all sizes, reflecting heightened demand for surgical procedures during the pandemic. However, by 2023, costs and quantities diminished, signifying a return to more standard surgical volumes.

Non-Sterile, Powdered Disposable Examination Gloves (Sizes Small, Medium, Large)

Non-sterile gloves were in high demand for routine examinations and non-surgical procedures. Data indicates that in 2020, JRMS acquired substantial

quantities of these gloves, especially in Size Medium (17,265,000 gloves). The price of these gloves escalated markedly in 2022, totaling \$1,166,175 for Size Medium. This increase illustrates the global competition for personal protective equipment, as examination gloves became essential for mitigating COVID-19 transmission. By 2023, both prices and quantities diminished, indicating enhanced market conditions and a decline in the urgent demand for PPE.

Un-Powdered Disposable Surgical Gloves (Sizes 6.5" to 8.0")

The acquisition of un-powdered gloves exhibited a distinct trend. These gloves, frequently favored in specific surgical and clinical environments, experienced consistently low procurement levels during the study period. Notably, procurement for these gloves remained minimal in 2020, with quantities varying from 4,800 (Size 6.5") to 50,778 (Size 7.0"). This tendency persisted in 2022, seeing very slight increase. The data indicates that un-powdered gloves were not a central focus of purchase during the pandemic, likely due to their specialized use and the prioritization of alternative glove types.

3.4 Comparative Analysis across Years

Upon analyzing the data over the four-year period, several significant tendencies become apparent:

- **2020 vs. 2022:** The disparity between 2020 and 2022 is substantial, with 2022 exhibiting substantial increases in both expenditure and volume. This illustrates the pressing need for medical gloves during the pandemic's peak, as healthcare institutions necessitated substantial quantities of personal protective equipment to safeguard personnel and patients.
- **2022 vs. 2023:** The shift from 2022 to 2023 reveals a reduction in both cost and quantity, signifying a stabilizing of demand. The JRMS's ongoing procurement of substantial glove quantities indicates that the most severe effects of the pandemic have subsided, facilitating more regulated and foreseeable procurement methods.
- **Inter-Glove Comparison:** Distinct glove types had divergent procurement patterns. For instance, non-sterile gloves saw the most pronounced fluctuations, whereas sterile gloves exhibited more mild variations. This disparity presumably indicates the more prevalent application of non-sterile gloves in diverse clinical environments, in contrast to the more targeted utilization of sterile gloves in surgical operations.

The data indicates a distinct trend of heightened glove purchase due to the COVID-19 pandemic, with 2022 marking the peak year for both expenditures and volumes. The lack of data in 2021 represents a significant gap that necessitates further examination, since it could uncover vital information into the JRMS's procurement policies during that time. The stabilization following the peak in 2023 indicates that the JRMS effectively navigated the pandemic's problems, harmonizing the demand for adequate supplies with the limitations of an unpredictable market.

4. DISCUSSION:

The data reveals that the JRMS encountered difficulties in reconciling supply and demand during the pandemic. The substantial rise in both cost and quantity in 2022 indicates the global scarcity of medical supplies and the resultant price escalations. The decrease in expenses and volumes in 2023 indicates market stabilization and maybe enhanced supply networks.

The absence of data for 2021 is significant and may suggest dependence on existing reserves or procurement difficulties that require more examination. This data deficiency may indicate the necessity for enhanced procurement tracking mechanisms inside the JRMS to guarantee uninterrupted supply during emergencies.

The study's results correspond with prior research regarding the effects of COVID-19 on healthcare procurement, highlighting prevalent issues of pricing volatility and supply chain disruptions. The JRMS's experience underscores the significance of strategic procurement planning and the necessity for adaptability in addressing extraordinary healthcare demands.

5. CONCLUSIONS:

The examination of JRMS's glove purchase trends from 2020 to 2023 indicates considerable variations in both price and volume, mostly influenced by the COVID-19 pandemic. The data reveals that 2022 represented the peak year for glove acquisitions, in both monetary value and quantity, succeeded by a period of stabilization in 2023. The results highlight the significance of robust supply chains and effective procurement planning in healthcare systems, especially during global emergencies.

CONSTRAINTS OF THE RESEARCH: The analysis depends exclusively on the supplied data, without additional contextual information to

elucidate the observed changes. Future research may be enhanced by a more extensive dataset and interviews with procurement officials to obtain a

more profound understanding of the decision-making processes throughout this period.

REFERENCES:

1. Miller FA, Young SB, Dobrow M, Shojanian KG. Vulnerability of the medical product supply chain: the wake-up call of COVID-19. *BMJ Qual Saf.* 2021 Apr;30(4):331-335. doi: 10.1136/bmjqs-2020-012133. Epub 2020 Nov 2. PMID: 33139342.
2. Ming X, Ray C, Bandari M. Beyond the PPE shortage: Improperly fitting personal protective equipment and COVID-19 transmission among health care professionals. *Hosp Pract (1995).* 2020 Dec;48(5):246-247. doi: 10.1080/21548331.2020.1802172. Epub 2020 Aug 11. PMID: 32713215.
3. Cordeiro L, Gnatta JR, Ciofi-Silva CL, Price A, de Oliveira NA, Almeida RMA, Mainardi GM, Srinivas S, Chan W, Levin ASS, Padoveze MC. Personal protective equipment implementation in healthcare: A scoping review. *Am J Infect Control.* 2022 Aug;50(8):898-905. doi: 10.1016/j.ajic.2022.01.013. PMID: 35908829.
4. *JMRS | HomePage.* (n.d.). <https://jrms.jaf.mil.jo/index.html>.
5. Okeagu CN, Reed DS, Sun L, Colantonio MM, Rezayev A, Ghaffar YA, Kaye RJ, Liu H, Cornett EM, Fox CJ, Urman RD, Kaye AD. Principles of supply chain management in the time of crisis. *Best Pract Res Clin Anaesthesiol.* 2021 Oct;35(3):369-376. doi: 10.1016/j.bpa.2020.11.007. Epub 2020 Nov 16. PMID: 34511225; PMCID: PMC8428474.
6. Snowdon AW, Saunders MJ. Supply chain capacity to respond to COVID-19 in Newfoundland and Labrador: An integrated leadership strategy. *Health Manage Forum.* 2022 Mar;35(2):71-79. doi: 10.1177/08404704211058414. Epub 2022 Feb 3. PMID: 35112917; PMCID: PMC8819564.
7. Moralejo D, El Dib R, Prata RA, Barretti P, Corrêa I. Improving adherence to Standard Precautions for the control of health care-associated infections. *Cochrane Database Syst Rev.* 2018 Feb 26;2(2):CD010768. doi: 10.1002/14651858.CD010768.pub2. PMID: 29481693; PMCID: PMC6491237.
8. Sarfraz A, Sarfraz Z, Anwer A, Sarfraz M, Siddiq J. Availability, Use, and Satisfaction of Personal Protective Equipment Among Healthcare Workers: A Cross-Sectional Assessment of Low- and Middle-Income Countries. *J Occup Environ Med.* 2020 Nov;62(11):e657-e664. doi: 10.1097/JOM.0000000000002028. PMID: 32956236.
9. Gan WH, Lim JW, Koh D, et al. Preventing intra-hospital infection and transmission of coronavirus disease 2019 in health-care workers. *Saf Health Work.* 2020;11(2):241-243.
10. COVID-19 Decontamination and Reuse of Filtering Facepiece Respirators. Centers for disease control and prevention, centers for disease control and prevention, 30 Apr 2020.
11. Parbhoo, A. N., et al. "COVID-19: Experience of a tertiary children's hospital in Western Cape Province, South Africa." *South African Medical Journal* 111.4 (2021): 295-298.
12. Haque M, Sartelli M, McKimm J, Abu Bakar M. Health care-associated infections - an overview. *Infect Drug Resist.* 2018 Nov 15;11:2321-2333. doi: 10.2147/IDR.S177247. PMID: 30532565; PMCID: PMC6245375.
13. Brito, Sávio Breno Pires, et al. "COVID-19 pandemic: the biggest challenge for the 21st century." *Vigil Sanit Debate* 8.2 (2020): 54-63.
14. Harrod M, Weston LE, Gregory L, Petersen L, Mayer J, Drews FA, Krein SL. A qualitative study of factors affecting personal protective equipment use among health care personnel. *Am J Infect Control.* 2020 Apr;48(4):410-415. doi: 10.1016/j.ajic.2019.08.031. Epub 2019 Oct 11. PMID: 31610895.
15. Clack L, Passerini S, Manser T, Sax H. Likelihood of Infectious Outcomes Following Infectious Risk Moments During Patient Care-An International Expert Consensus Study and Quantitative Risk Index. *Infect Control Hosp Epidemiol.* 2018 Mar;39(3):280-289. doi: 10.1017/ice.2017.327. PMID: 29498340.
16. Parbhoo, A. N., et al. "COVID-19: Experience of a tertiary children's hospital in Western Cape Province, South Africa." *South African Medical Journal* 111.4 (2021): 295-298.

17. Pokrajac N, Schertzer K, Poffenberger CM, Alvarez A, Marin-Nevarez P, Winstead-Derlega C, Gisoni MA. Mastery Learning Ensures Correct Personal Protective Equipment Use in Simulated Clinical

Encounters of COVID-19. West J Emerg Med. 2020 Jul 21;21(5):1089-1094. doi: 10.5811/westjem.2020.6.48132. PMID: 32970559; PMCID: PMC7514383.

CONFLICT OF INTEREST REPORTED: NIL;

SOURCE OF FUNDING: NONE REPORTED