# Nurse's role in processing materials for robotic surgery: experience report

*Atuação do enfermeiro no processamento de materiais para cirurgia robótica: relato de experiência*

*Actuación del enfermero en el procesamiento de materiales para cirugía robótica: relato de experiencia*

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**ABSTRACT: Objective:** To report the experience of nurses in the processing of materials for robotic surgery in two Sterile Processing Departments (SPD), comparing the processes. **Methods:** Experience report based on the practices of two nurses working with robotic surgery material processing in two Class II SPDs located in southern Brazil. **Results:** Similar processing steps were identified, including pre-preparation, reception and inspection, pre-cleaning, manual cleaning and rinsing, automated cleaning, drying, final inspection and lubrication, packaging, sterilization, and storage. Steps performed in Institution A but not in B included filling and immersion, as well as adenosine triphosphate (ATP) testing. **Conclusion:** Sharing knowledge and promoting best practices in material processing is essential, given the importance of controlling healthcare-associated infections, particularly surgical site infections, which are among the main postoperative complications.
**Keywords:** Nurses. Robotics. Sterilization. Surgical instruments. Materials management, hospital.

**RESUMO: Objetivo:** Relatar a experiência da atuação de enfermeiras no processamento de materiais para cirurgia robótica em dois centros de materiais e esterilização, comparando os processos. **Métodos:** Relato da experiência das vivências de duas enfermeiras que atuam no processamento de materiais de cirurgia robótica em dois centros de materiais e esterilização classe II localizados no Sul do Brasil. **Resultados:** Identificaram-se etapas de processamento afins, que consistem em pré-preparo, recepção e inspeção, pré-limpeza, limpeza manual e enxágue, limpeza automatizada, secar, inspeção final e lubrificar, embalar, esterilizar e armazenar. As fases realizadas na instituição A, e que não ocorrem na B, são preencher e submergir e o teste da adenosina trifosfato. **Conclusão:** Compartilhar o conhecimento, promovendo as boas práticas no processamento, é indispensável, dada a importância do controle de infecções relacionadas à assistência à saúde, em especial aquelas de sítio cirúrgico, uma das principais complicações no pós-operatório.
**Palavras-chave:** Enfermeiros. Robótica. Esterilização. Instrumentos cirúrgicos. Administração de materiais no hospital.

**RESUMEN: Objetivo:** Relatar la experiencia de enfermeras en el procesamiento de materiales para cirugía robótica en dos centros de materiales y esterilización, comparando los procesos. **Métodos:** Relato de la experiencia de dos enfermeras que trabajan en el procesamiento de materiales de cirugía robótica en dos centros de materiales y esterilización clase II ubicados en el sur de Brasil. **Resultados:** Se identificaron etapas de procesamiento similares, que consisten en pre-preparación, recepción e inspección, pre-limpieza, limpieza manual y enjuague, limpieza automatizada, secado, inspección final y lubricación, embalaje, esterilización y almacenamiento. Las fases realizadas en la institución A y que no ocurren en B son: llenar y sumergir, y la prueba de trifosfato de adenosina. **Conclusión:** Compartir el conocimiento y promover las buenas prácticas en el procesamiento es indispensable, dada la importancia del control de infecciones asociadas a la atención en salud, especialmente las infecciones del sitio quirúrgico, una de las principales complicaciones en el postoperatorio.
**Palabras clave:** Enfermeros. Robótica. Esterilización. Instrumentos quirúrgicos. Administración de materiales de hospital.

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## INTRODUCTION

Increased life expectancy and the rising prevalence of chronic diseases have added complexity to anesthetic and surgical procedures[1]. Worldwide, an estimated 310 million surgeries are performed each year, and this number continues to grow[2]. These developments present ongoing challenges for healthcare institutions in light of scientific and technological progress[1].

Over the past two decades, laparoscopic surgeries have gained prominence over open procedures, as they provide enhanced visualization of anatomical structures, increased maneuverability during the technique, and faster patient recovery. The term robot, meaning servant or worker, originated in the 1920s and was initially applied in the military context to stabilize the wounded on the battlefield. In 1998, an advanced model of robot-assisted surgery, the Da Vinci platform[3], was introduced and is currently available at the institutions discussed in this report. This technology offers several advantages for minimally invasive procedures, including stable three-dimensional imaging, reduced hand tremors, and greater instrument mobility[3]. These features enable the performance of complex surgeries with smaller incisions, less tissue trauma, fewer adhesions, and reduced postoperative complications, ultimately facilitating earlier patient discharge[4].

The evolution of surgical practice has led to advances in instruments, making them increasingly complex, which poses challenges for nursing teams and demands the development of skills to manage and establish efficient reuse flows for these devices. Within this context, the nursing team at the Sterile Processing Department (SPD) plays a pivotal role in processing robotic materials. Defined as a functional unit[5], it is dedicated to processing healthcare products (HCPs) for healthcare services and is responsible for ensuring that materials are processed in adequate quality and quantity to support safe patient care.

The SPD is classified into Class I and Class II, both responsible for processing HCPs. Class I units handle non-critical, semi-critical, and critical products of non-complex design, whereas Class II units also process critical products with complex conformation. This sector encompasses pre-cleaning, reception, cleaning, drying, integrity and functionality assessment, preparation, disinfection and/or sterilization, storage, and distribution to consumer units[5]. Therefore, adherence to recommended best practices in HCPs processing is essential to ensure process safety and minimize adverse events, particularly health-associated infections (HAIs) related to the use of these materials in patient care[6].

This report emerged from observations regarding the challenges associated with processing robotic HCPs, which are complex and high-cost materials, highlighting the importance of their effective management and the need for broader discussion on the subject.

## OBJECTIVES

To describe the experience of nurses in processing materials for robotic surgery at two SPDs, with a comparison of the respective processes.

## METHODS

This experience report describes the work of two nurses in the Class II SPD of two institutions in Southern Brazil. To ensure confidentiality and protect the identities of the hospitals, they have been designated as Institution A (IA) and Institution B (IB). Authorization for this article was obtained from the supervisors of both institutions.

IA is a large private hospital performing an average of 2,000 surgeries per month, including 58 procedures using the Da Vinci Xi robot. Of the 18 operating rooms in the surgicenter (SC), one is equipped with the Da Vinci Xi platform, supporting urology, colorectal proctology, gynecology, general surgery, and thoracic procedures. SPD meets both internal and external hospital network demands, sterilizing approximately 53,000 items per month from outpatient, surgical, and inpatient care. Regarding robotic instruments, an average of 550 items per month (1.04%) are handled.

IB is a large philanthropic hospital with 59 operating rooms, performing an average of 4,500 surgeries per month. It currently operates a Da Vinci Xi robot, performing approximately 60 procedures monthly across digestive tract, coloproctology, gynecology, urology, and thoracic specialties, and is a pioneer in head and neck surgeries as well as pediatric procedures. The SPD serves eight hospitals in both surgical and non-surgical care, sterilizing approximately 80,000 packages per month, including an average of 600 items (0.75%) used in robotic surgery.

## RESULTS

The study compared two institutions utilizing the Da Vinci Xi robotic system. Chart 1 presents the similarities in robotic surgery material processing between the institutions, while Chart 2 highlights the differences.

## DISCUSSION

Reusable robotic surgery materials of the Da Vinci Xi system include optics, instruments, and accessories, each requiring specific processing protocols and specialized knowledge of the technological apparatus. Robotic forceps are classified as critical HCPs with complex shapes, featuring lumens smaller than 5 mm or blind ends, as well as internal spaces that are inaccessible to direct friction, recesses, or valves[5]. To enhance patient safety and minimize the risk of processing errors, it is essential to implement pre-cleaning protocols for robotic materials both intraoperatively and at the end of surgery[7].

A study[8] demonstrated that after 30 minutes, the impregnation of organic matter prevents its removal by immersion in distilled water alone, highlighting that early humidification reduces residual contamination. This finding supports the practice of cleaning and humidifying materials in the SC using distilled water. The contraindication of saline solution is emphasized due to its risk of causing corrosion[9], which aligns with the procedures adopted in these institutions.

Pre-cleaning is intended to remove visible debris, followed by disinfection, which requires immersion of the instruments in a neutral-pH enzymatic solution prepared according to the manufacturer's instructions. The specialized enzymes (protease, lipase, amylase) facilitate the dissolution of proteinaceous material, supporting subsequent manual cleaning[7,9]. However, pre-cleaning practices may vary among institutions, with immersion sometimes employed as an additional step.

Comparison between the two institutions reveals notable practical implications. Although both maintain similar practices for the care and cleaning of instruments in the surgical center, including keeping them moist, IB performs pre-cleaning immediately upon receipt in the SPD, in accordance with guidelines from the *Associação Brasileira de Enfermeiros de Centro Cirúrgico, Recuperação Anestésica e Centro de Material e Esterilização* (SOBECC)[6]. In contrast, IA allows up to a 60-minute interval before pre-cleaning. Delays of this nature can hinder the removal of organic matter, as dried residue is more difficult to eliminate, reducing processing efficiency and potentially increasing the risk of HAIs[8].

Another notable difference between the institutions is observed in the "fill and emerge" step, which is performed only at IA. This procedure promotes hydration of adhered debris, facilitating manual cleaning, particularly for complex

**Chart 1.** Similarities in the processing of robotic surgery materials among the Sterile Processing Departments of the institutions compared in this study. October 2024.

| Steps | IA and IB |
|---|---|
| Materials Used | Da Vinci Xi, endoscope, EndoWrist forceps, and accessories. |
| Care and cleaning | Cleaned at the end of the surgery by the scrub nurse using sterile distilled water–moistened gauze and a *luer* slip syringe (tip) for lumen irrigation (pre-moistening). |
| Post-use inspection in the SC | Nurse inspects and marks the number of uses with a permanent marker. |
| Reception and inspection at the SPD | Verification of received items. Continuous and unidirectional workflow. |
| Manual cleaning and rinsing | Neutral detergent, non-abrasive sponge, and nylon brush. Rinse with running and pressurized water (30 PSI). |
| Drying | Disposable cleaning cloths and compressed air at a maximum pressure of 2 bars (30 PSI) applied to irrigation ports and exterior of the forceps. |
| Final inspection and lubrication | Dedicated workstation with magnifying glass, checking for residues or damage.<br>Apply neutral pH, vapor-permeable lubricant to cables, pulleys, and instrument rotation pins. |
| Packaging | Forceps: double-layer surgical paper, labeled according to regulations. Endoscope: dedicated box, wrapped in polypropylene blanket |
| Sterilization | Forceps: steam autoclave on the instrument cycle at 134°C. Endoscope: hydrogen peroxide plasma. Both monitored with biological and chemical indicators. |
| Storage | Clean, dry area on shelves with controlled temperature and humidity. |

IA: institution A; IB: institution B; SC: surgicenter; SPD: Sterile Processing Department.

**Chart 2.** Differences in robotic surgery material processing between the Sterile Processing Departments of the institutions compared in this study. October 2024.

| Steps | IA | IB |
|---|---|---|
| Transport to SPD | Materials segregated in boxes with lids. | Materials segregated in boxes with lids and endoscope wrapped in a pyramidal cushion. |
| Pre-cleaning | Started <60 minutes after use. | Started immediately. |
| Filling and immersion | Complete immersion of forceps in enzymatic detergent solution for 5 minutes (concentration and temperature according to manufacturer), filling the primary port with 15 mL. | Not performed. |
| Automated cleaning | Ultrasonic washer and thermo-disinfector "PCF Innowave", cycle "P1 Robot Disinfection" (~60 minutes, enzymatic detergent). Stages and times: pre-wash (3–5 min), wash 40–50°C (10–15 min), rinse (5 min), disinfection 90–93°C (10–15 min), cooling/drying (15–20 min). Specific cycle for robotic instruments, ideal for delicate materials. | Ultrasonic washer and thermo-disinfector "Medisafe PCF-S", cycle "P6" (~70 minutes, alkaline and enzymatic detergent). Stages and times: pre-wash (5 min), wash 40–50°C (10–12 min), rinse (10–20 min), disinfection 90–93°C (10–15 min), cooling/drying (20–25 min). Effective for persistent dirt. Not specific for robotic instruments. |
| ATP Testing | Every cycle containing robotic forceps;<br>Surface sample: needle port and monopolar scissors;<br>Cannula sample: monopolar scissors via distilled water injection into lumen. | Surface sampling weekly. |
| Nursing team responsibilities | Nurse: forceps and endoscope;<br>Nursing technician: accessories. | All processing assigned to nurse. |

IA: institution A; IB: institution B; SPD: Sterile Processing Department; ATP: adenosine triphosphate.

HCPs such as robotic forceps[6,7]. However, it should be noted that IB initiates instrument cleaning immediately after use, in accordance with SOBECC recommendations[6].

Cleaning is intended to remove organic and inorganic debris, thereby reducing microbial load[5]. This process involves the use of water, detergents, and specialized products, combined with mechanical action, either manual or automated, applied to both the internal (lumens) and external surfaces of the instruments, preparing them for subsequent disinfection or sterilization. Robotic instruments require particular attention, including irrigation and inspection of lumens to ensure complete removal of residues without compromising functionality[9].

A difference between the institutions is observed during the "automated cleaning" stage. IA employs enzymatic detergent in equipment with a cycle specifically designed for robotic instruments, whereas IB uses both enzymatic and alkaline detergents. Although alkaline detergent is more effective at removing debris, it increases the risk of instrument wear and corrosion, necessitating strict monitoring[5].

For HCPs with complex configurations in Class II SPD and processing centers, cleaning should be performed manually and supplemented by automated processes using ultrasonic washers or validated equipment. Automated cleaning must employ an ultrasonic washer equipped with a suitable instrument connector and intermittent flow technology, particularly for HCPs with lumens smaller than 5 mm[5]. Cleaning effectiveness is validated using the adenosine triphosphate (ATP) test as a marker of organic matter[9].

Regarding cleaning validation, IA conducts ATP testing on robotic clamps during every cycle, whereas IB performs this control on a weekly basis. ATP testing is essential to validate cleaning effectiveness and minimize contamination risks[10]; less frequent testing may fail to detect cleaning deficiencies, potentially compromising patient safety.

To prevent damage to robotic materials, sterilization should be performed using equipment with validated parameters and cycles, in accordance with AAMI/ISO 17665-1 or BS EN ISO 17665-1 recommendations. Additionally, the sterilization process must be routinely monitored to ensure compliance with these standards. While both institutions employ appropriate methods to preserve material integrity, IB uniquely uses a pyramid mattress during "transport to the SPD," providing additional protection for the instruments.

In Brazil, SPD nurses are responsible for the handling of robotic optics and forceps and are required to work exclusively in this unit throughout their shifts to ensure that tasks are performed with quality, responsibility, and technical-scientific competence[5]. In the "nursing team duties" stage, IB assigns all processing of robotic instruments exclusively to the nurse, which facilitates process control but may contribute to workload overload. In contrast, IA shares this responsibility with nursing technicians, representing an operational advantage, provided that adequate supervision and training are maintained.

The limitations of this study include potential interference arising from differences between the institutions, such as variations in physical space, workload, and operational routines. Additionally, the absence of specific national guidelines for processing robotic surgery instruments necessitates reliance on manufacturers' manuals and recommendations, as well as adaptation from workflows used for video-assisted surgery instruments, given the similarities in procedural requirements.

## CONCLUSION

This study described the experiences of nurses in two SPD in Southern Brazil involved in processing materials for robotic surgery. Comparison of the processing practices revealed both similarities and differences between the institutions. The findings underscore the importance of disseminating knowledge of best practices to prevent healthcare-associated infections, particularly surgical site infections. In this context, nurses must be well-versed in current best practices and relevant legislation, actively contributing to the selection of indicators that evaluate process quality.

## FUNDING

None.

## CONFLICT OF INTERESTS

The authors declare there is no conflict of interests.

## AUTHORS' CONTRIBUTION

SVR: Conceptualization, Data curation, Investigation, Methodology, Resources, Writing – original draft. FUCR: Conceptualization, Data curation, Investigation, Methodology, Resources, Writing – original draft. PC: Resources, Writing – review & editing, Visualization. DWS: Resources, Writing – review & editing. RCAC: Project administration, Formal analysis, Resources, Supervision, Validation.

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