

SUPPLEMENTARY MATERIAL 1.
Protocol for central venous catheter insertion

PROGRAM FOR HAI PREVENTION
Protocol for central venous access insertion

Steps to follow in the placement of central lines:

Operator

1. Wear cap and mask.
2. Hand hygiene (as per protocol).
3. Adequate positioning of the patient (depending on the site of IV insertion).
4. Open the central line placement kit on a table placed at the side of the bed, unfolding the first sterile field on it.
5. Repeat hand hygiene.
6. Put on sterile gloves (pair provided in the kit).
7. Clean the insertion site with 2% chlorhexidine. Cleaning should be performed by rubbing (*front to back movement. NOT circular motion*) the site for at least 30 seconds and preferably for 2 minutes, using the gauze and plastic clamp provided in the kit. Wait for the antiseptic to dry before starting the procedure.
8. Remove gloves.
9. Put on gown (provided in the kit).
10. Put on sterile gloves (these will be handed by the assistant because they must correspond to the number used by the operator).
11. Take the adhesive fenestrated field (provided in the kit) and place it around the site of insertion.
12. Open the catheter (not provided in the kit. Handed by the assistant). Place it on the table, check the displacement of the piano wire.
13. Open the container containing the syringe, three-way stopcocks, suture, scalpel, gauze, saline solution (provided in the kit) on the table.
14. Flush the catheter and three-way stopcock with sterile saline solution (provided in the kit).
15. Insert the catheter following the technique.
16. Fix the catheter with stitches to the skin at 1 cm from the insertion site.
17. Remove fields.
18. Clean blood remains with 2% chlorhexidine and place a small piece of gauze in the fixation site.
19. Place Tegaderm™ (transparent film dressing).

Assistant

The assistant who will hand the items necessary for IV insertion (not provided in the kit) must wear a cap and a mask and wash their hands properly.

If the assistant will participate in any step of IV insertion, they must wear a cap, a mask, a gown, and sterile gloves.

There shall be no observers within 1 meter. If there are any, they should wear a cap and a mask.

Observations

Catheters inserted during an emergency where the protocol was not complied with must be removed within 48 hours.

SUPPLEMENTARY MATERIAL 2.

Activities carried out in the pre-intervention and post-intervention periods

First stage: situation diagnosis (2008).

- It included direct observation, use of instruments to measure adherence to hand hygiene, surveillance of bacteremias, and compliance with isolation measures according to the mode of microorganism dissemination.
- Meetings were held in the different shifts with all members of the unit (nurses, attending physicians, residents, and technical staff).

Result: health care providers lacked knowledge and perception of the infections existing in the unit.

- Catheters were inserted by nurses, intensivists, and anesthesiologists in the operating room (approximately 80%), which made the approach to the problem very complex.
- Catheter care was performed by the nursing staff (cures, preparation of intravenous solutions and administration).
- Adherence to hand hygiene by both physicians and nurses in the unit did not exceed 20% (observed before and after contact with the patient).
- Indiscriminate use of antiseptics (2% chlorhexidine or 10% povidone iodine), with different application techniques.
- Partial or no compliance with the sterile technique of catheter insertion in the unit and in the operating room.

Second stage: Intervention strategies (2009-2018). Consecutive activities implemented.

Once the existing factors were identified, a global intervention program was developed, including the staff from the PCICU and the operating room working on cardiac surgery. A set of evidence-based strategies and bundles was established. It includes a group of basic practices based on scientific evidence that, when implemented together, improved the quality of care related to invasive procedures. The bundle model was developed by the Institute for Healthcare Improvement.¹⁰

- A working group made up of nurses, physicians, surgical technologists, and technical personnel was created and coordinated by the Department of Epidemiology and Infectology.
- The role of the liaison nurse (local, opinion leader nurse) was created, whose function was to reinforce and enforce on-site infection control recommendations.
- Monthly meetings were planned with the unit staff and newly hired staff to raise awareness of the importance of adhering to infection control recommendations, with emphasis on hand hygiene and CVC-related care.
- Short meetings were planned for each nursing shift; firstly, to inform about the strategies to be implemented and, secondly, to inform about the fulfillment of the objectives as the program progressed.
- Hand hygiene adherence observations were conducted for the entire PCICU health care team, and results were posted on a bulletin board.
- Bacteremia rates were posted on a monthly basis. The work team was congratulated as improvements in processes and decreases in rates were observed.
- A checklist was drawn up for use both in the operating room and the unit. It included the practices chosen for catheter insertion: hand hygiene, kit of items required for insertion, adequate antisepsis of the insertion site with 2% chlorhexidine, application by gentle rubbing, and use of maximum barriers for the patient and the operator.
- A protocol describing the steps for venous line insertion was developed and made known to all providers involved in the procedure.
- Checklists for the preparation and administration of intravenous solutions and caring of the CVC insertion site were also applied.
- Observation of cleaning and disinfection of patient and environment surfaces and equipment (monitors, pumps, etc.) according to recommendations.¹¹

SUPPLEMENTARY MATERIAL 3.

Definitions of the variables used for epidemiological surveillance during the program according to the Centers for Disease Control and Prevention

The epidemiological and surveillance definition of the United States Centers for Disease Control and Prevention (CDC)'s National Healthcare Safety Network (NHSN) is "any patient who develops bacteremia with a central catheter inserted 48 hours prior to the development of bacteremia, and who does not have another site of infection to which the bacteremia can be attributed".¹² This definition is highly sensitive but not very specific, since it certainly overestimates the true incidence of episodes of central venous catheter-associated infections (CAI), but most centers in the world use it as a reference for surveillance and reporting. This definition is the one used in Argentina by the National Hospital Infection Control and Epidemiology Program (VIHDA).

The rate used to estimate infections associated with invasive procedures is obtained by using the number of episodes of infections occurring in a month as numerator and the number of days of use of the procedure (patients exposed) in that month as denominator. The result is multiplied by a factor of 1000 to obtain the incidence density rate.

$$\text{Formula: } \frac{\text{No. of HAI episodes associated with invasive procedures:}}{\text{No. of days of exposure to the procedure}} \times 1000$$

To estimate the use rate per components, the numerator is the number of days of use of the procedure under study (e.g., days of CVC use) during a given period and the denominator is the total number of days with patients admitted to the study unit during the same period. The result is multiplied by 100 and the rate is indicated as a percentage.

$$\text{Formula: } \frac{\text{No. of days of invasive procedure}}{\text{No. of patient days}} \times 100$$

Standardized infection ratio (SIR): it is the result of dividing the number of observed infections by the number of expected infections.

The number of expected infections is estimated using infection probabilities obtained from multivariate logistic regression models developed using data over a base time period, which represents the standardized population of infections. The SIR is calculated only if the number is greater than 1, to meet a minimum accuracy criterion.