

Original Article

Using the knowledge translation framework to change practical care of central catheters in a Brazilian neonatal unit

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Abstract

Introduction: The use of central catheters in intensive care is essential, but exposes the patient to the risk of a bloodstream infection. Although there is evidence to improve the care for these patients, there is a gap between knowledge and healthcare practices. This study was designed to describe the bundle implementation for central catheters in light of the knowledge translation (KT) conceptual framework in a neonatal unit and assess its impact on care practices with catheters.

Methodology: A time-series quasi-experimental study design was conducted in a Brazilian neonatal unit, through 289 non-participant observations of professional practices before and after the implementation of the bundles.

Results: The deployment of two bundles was guided through the steps of a careful selection of adopting KT evidence and context-related and investment factors in the facilitation process. The implementation of the bundles was planned by a group manager, mediated by a facilitator, and guided by targets established by professionals. The biggest impact was on the maintenance of catheters; seven of eleven practices improved significantly ($p < 0.01$). The insertion of catheters showed lesser impact of change, with high adequacy ratios before implementation, but also presented satisfactory adherence to recommendations.

Conclusions: This is the first Brazilian study using the KT conceptual framework to develop, implement, and evaluate the impact of central line bundles in a neonatal care environment, detailing the implementation process. It highlights the importance of accountability and staff involvement in all stages of the study.

Key words: Catheter-related infections; infection control; neonatal intensive care units; quality of health care; preventive actions; evidence-based practice.

J Infect Dev Ctries 2017; 11(6):445-452. doi:10.3855/jidc.7916

(Received 11 November 2015 – Accepted 13 May 2016)

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Introduction

The use of central catheters is highly common and useful in intensive care units (ICUs). It is estimated that approximately half (48%) of the patients in intensive care have at least one central catheter, totaling 15 million catheter-days per year in ICUs in the United States [1]. However, there are risks associated with the use of this type of catheter, with an average of five central catheter infections for every 1,000 catheter-days in American ICUs. As the mortality attributable to such infections is 18%, 14,000 deaths may occur every year in the United States because of these infections, and some estimates indicate even higher rates of around 28,000 deaths [1].

Due to the presence of peculiar characteristics, newborns in the ICU comprise a population vulnerable to healthcare-related infections, including of catheter-associated bloodstream infection (CABSI). The CABSI density in Brazilian neonatal units was between 10.5

and 12.5 per 1,000 catheter-days in 2011 [2]. These figures are high compared to the international ones [3-7].

In the context of improving the quality of care, studies [8-9] indicate that although there is massive global investment in research to produce evidence, health systems cannot guarantee the implementation of programs, services, and products from the latest research evidence.

Over the past 10–15 years, international policies and the attention to research on how to reduce the gap between scientific evidence and health practices and policies have grown [8]. Research for primary knowledge production is as important as studies on how to transfer it to practice.

In this sense, the conceptual framework knowledge translation (KT) was created, emphasizing networking and exchange models between the production of scientific evidence and care practices [10]. KT is a

dynamic and interactive process to improve services and the health system that is developed in stages of synthesis, diffusion, exchange, and ethical application of knowledge. [11].

Various studies have compared infection rates before and after the implementation of bundles for central catheters in neonatal units; these consist of a set of evidence-based practices proven to improve the outcomes of patient care [12]. However, such studies did not adopt a conceptual benchmark to guide the way to implement such evidence [3-7,13]. In addition, comparisons of the changes of catheter insertion and maintenance before and after the intervention are lacking.

Considering the complexity of the changing processes and the conceptual model adopted, this study aimed to describe the implementation process of two bundles for the insertion and maintenance of central venous catheter (CVCs) in the light of the KT conceptual benchmark in a neonatal unit, and to assess the impact of these bundles on care practices for the insertion and maintenance of catheters.

Methodology

A quasi-experimental time-series study design held in the neonatal unit of a university hospital in southern Brazil was approved by the research ethics committee of the institution (CAAE 17541613.5.0000.5231). The bundles for insertion and maintenance of CVC were drawn from discussions with the neonatal unit team and an integrative literature review that has been submitted but not yet published. The survey was developed in three phases: September 2013 to February 2014 (pre-implementation bundle), May to October 2014 (implementation), and November and December 2014 (post-implementation).

The conceptual knowledge-to-action [14] model was used to guide the implementation, consisting of the following steps: 1) identification of the problem; 2) identification, review, and selection of knowledge; 3) adaptation of knowledge to the local context; 4) evaluation of barriers to the use of knowledge; 5) selection, design, and implementation of interventions; 6) monitoring the use of knowledge; 7) evaluation of results; and 8) use of knowledge support.

The impact of the bundles was measured by non-participant observation team practices on insertion of catheters and maintenance of catheters, using two instruments in a checklist format to verify the adequacy of the practices performed by professionals of the unit with recommendations based on the scientific evidence contained in the bundles. The purpose of the

observation was hidden, and when observers were asked about their presence, they claimed they were monitoring quality of care.

Procedures for data collection

The non-participant observation of the insertion and maintenance practices of CVC was run by nurses working in neonatal nursing and nursing students trained in a pilot test on the method and collection instruments.

All the catheter insertions in the unit in the period of the survey were targets of observation, and the trained observer was warned systematically about such opportunities. Because it is a teaching hospital, the professionals who usually install the CVC are medical and nursing residents who rotate every year.

The catheter maintenance observation was done when the collectors periodically visited the neonatal unit on all shifts and chose up to three patients with a CVC for observation. The criteria for selection of patients were based on proximity of the allocation of the patients in the unit environment and drug administration schedules. The non-participant observation was done for about one to two hours, and the checklist on the adequacy of practices was completed.

Statistical analysis

The maintenance of CVCs is practiced by individualized professional actions and by actions resulting from a collective work by two or more staff professionals; therefore, responsibility cannot be assigned to a single individual. In this sense, the unit of observation and data analysis of the practices relating to the insertion of the CVC was the professional action, while the observed practices relating to the maintenance of the CVC were both professional and team actions.

The statistical analysis of the professional practice observation in the integration of the CVC was performed by repeated measurements with paired samples.

For the analysis of CVC insertion practices on responsibility assigned to the professional, pre-and post-implementation of the bundle were considered dependent samples. The sample size calculation was based on the hypothesis of a difference of 35% in the improvement of practices, a power of the 80% test at a 5% significance level, indicating 20 professionals to be observed. The same 15 pre-professional implementations and post-implementations were observed, totaling 30 observations of CVC insertion, with a loss of 25% of the sample calculated by an

exchange of reason on the scale, holidays, and leave at the time of collection after the intervention.

For the analysis of professional practices in CVC maintenance responsibility assigned to the team, paired samples were not considered, and the calculation was based on the assumption of a 10% difference in the improvement of practices, with a power of the 90% test and 5% significance level, indicating a sample size of 101. There were 120 and 122 CVC maintenance observations collected in pre- and post-implementation, respectively.

Results

Pre-implementation of the bundles

The pre-implementation phase of the bundles consisted of situational diagnosis of the context of unity, synthesis of the existing evidence, and identification of barriers and facilitators through an interactive process with the team and the group manager.

The situational diagnosis was carried out through non-participant observation between September 2013 and February 2014. It measured the increase of the average rate of CASBI and the adequacy rate of evidence-based practices used to prevent infections caused by insertion and maintenance of catheters.

The scientific evidence on infection prevention and implementation strategies of bundles for infection were raised and synthesized in order to guide consensus on evidence-based practices for catheter insertion and

maintenance. Details of this review will be published in another article, which is still in the submission process.

The manager group was made up of people strategically chosen based on their complementary views about the drive: two nurses, a resident of neonatal nursing, a nurse technician, a neonatologist, a pediatric infectious disease physician, and a nurse on the hospital infection control committee, who voluntarily accepted the mission of defining implementation strategies, mediated by a facilitator role played by one of the researchers.

The data of the situational diagnosis and the summary of evidence was presented by the facilitator to the group manager. From the level of scientific evidence and local data, the barriers and facilitators to implementation of the recommended in neonatal unit were discussed, the development of a bundle for inserting catheters and a bundle for maintenance of catheters (Table 1) was defined. The group manager also drew up an action plan to define knowledge transfer strategies for implementing the bundles (*e.g.*, reminders, educational interventions, audit, and feedback).

Bundle implementation processes

To implement the bundles, various actions were carried out for the dissemination and exchange with the neonatal unit multidisciplinary team in meetings with small groups and with the group manager.

Over the study's 18-month period, 21 meetings occurred with teams of different shifts, with the medical

Table 1. Catheter insertion and maintenance bundles (Londrina, Paraná, Brazil, 2014).

Catheter insertion bundle	
Recommendations	Level of evidence
1) Hand hygiene with chlorhexidine degermant	IA
2) Maintain preassembled insertion kits	IB
3) Use maximum barrier of CVC insertion	IA
4) Skin cleansing with chlorhexidine 0.2% or 0.4% (first degermant after alcohol to RN > 1,500 g, or aqueous to < 1,500 g) and let dry completely	IA
5) Sterile transparent semipermeable dressing or use sterile gauze	IA
6) Use exclusive team with specific training for insertion technique of standardization and maintenance of the peripherally inserted central catheter	IB
Catheter maintenance bundle	
Recommendations	Level of evidence
1) Hand hygiene with chlorhexidine antiseptic degermant and standardized by CCIH protocols	IA
2) Evaluation of the need for daily catheter change	
3) Maintain exclusive entry for parenteral nutrition*	IB
4) Exclusive team for catheter maintenance	IA
5) Standardization of appropriate care with the infusion system	IB
6) Standardization of appropriate care with the dressing**	IA

CVC: central venous catheter; * Adaptation to local context recommendation IA "Minimize access routes of the catheter; ** Summary of recommendations; "Use sterile transparent semipermeable dressing or sterile gauze" and IB "Change the dressing if dirty, wet or loose or sticking".

team, with the team of infant surgery, and with the group manager. Other meeting between the team and the facilitator also occurred outside the formal meetings, during the accomplishments of facilitation strategies in the post-implementation phase (dynamics, video exhibitions, etc).

The neonatal unit team established targets for the appropriateness of the care and maintenance of catheter insertion based on the bundles. The facilitator presented each recommendation, based on evidence contained in bundles, and the percentage of adequacy of the practices of insertion and maintenance of catheters in the situational diagnosis performed in the unit (*e.g.*, correct technique of hand hygiene, identified in 13% of pre-implementation observations of the bundle). Then, the barriers and facilitators to the implementation of each recommendation were discussed. Each participant was also asked to suggest a measurable and feasible goal to be achieved in the implementation of each recommendation of bundles, which was recorded in the diary of the facilitator. After meeting with teams of four shifts, the average of the goals suggested by the team were calculated and discussed and validated with the group manager later.

As a feedback strategy and reminder to staff, two banners in the style of traffic lights were displayed at the neonatal unit, with recommendations about insertion of bundles and maintenance of CVC. The percentage of insertion and maintenance practices of catheters observed in the conducted situational diagnosis the unit were classified as green, yellow, and red, and the related goals set by the team (Tables 2 and 3) were displayed.

A care protocol was also prepared by the facilitator for the integration and maintenance of a neonatal peripherally inserted central catheter (PICC), based on the evidence systematized in an integrative review (not yet published) and from pre-existing institutional teaching materials. The creation of this protocol resulted in the formation and training of a specific group for insertion of a PICC in newborns.

Reminders were also imposed in the form of posters to stimulate and motivate the neonatal unit team to adhere to the bundles. Reminders with the proper technique of hand hygiene and staff performance of the technique were placed in all the sinks in the unit. In addition, comic cartoons about the fight against

Table 2. Professional practices in the insertions of catheters (Londrina, Paraná, Brazil, 2014).

Professional practices	Pre-adequacy		Goal	Post-adequacy		p*
	n	%		n	%	
Proper handwashing	12	100	100	5	100	--
Degermant chlorhexidine in handwashing	12	100	100	4	100	--
Appropriate sterile dressing	10	100	100	5	100	--
Use of maximum sterile barrier	12	100	100	5	100	--
Alcoholic chlorhexidine for antisepsis	12	100	100	5	100	--
Handwashing technique	11	92	100	4	100	0.55
Wait to dry for puncturing	4	33	100	5	100	0.01

* Statistically significant when $p < 0.05$.

Table 3. Professional practices in the maintenance of catheters (Londrina, Paraná, Brazil, 2014).

Professional practices	Pre-adequacy		Goal	Post-adequacy		p*
	n	%		n	%	
Handwashing before and after handling the CVC	3	23	78	11	85	< 0.01
Handwashing technique	1	10	69	8	80	< 0.01
Friction of the connectors by 30''	5	45	95	9	82	0.18
Maintenance of the closed system	15	100	100	15	100	--
Team practices	Pre-adequacy		Goal	Post-adequacy		p*
	%	%		%	%	
Availability of liquid alcohol	109	91	95	117	99	< 0.01
Alcoholic chlorhexidine availability	113	94	95	98	84	< 0.01
Dated equipment and up to date	88	86	95	114	97	< 0.01
Proper care with dressing	100	88	100	111	98	< 0.01
PN in exclusive catheter	49	49	89	69	90	< 0.01
Umbilical catheter for up to 7 days	6	86	100	11	100	0.20
Central line maintained only if necessary	118	98	100	117	97	0.41

CVC: central venous catheter; PN: parenteral nutrition; *Statistically significant p value when < 0.05 .

nosocomial bacteria were placed in strategic locations (*e.g.*, in front of the worktops and in sinks).

In August 2014, an audit of the insertion and maintenance of catheter practices by the team for 15 days through observations was performed. In addition, the calculation of CABS rates was monitored monthly throughout the deployment period in order to support partial feedback of the team's performance, and was presented at the meeting discussion between the facilitator and the group manager.

Subsequently a feedback meeting to present the audit results was conducted in August 2014, the implementation process was discussed to propose new knowledge transfer strategies to achieve the goals.

The new KT strategies were: 1) use of a dark box of hand hygiene, comprising alcohol gel mixed with a luminescent material and a dark box illuminated with a black light lamp, which allow visualization of areas of poorly sanitized hands; 2) artistic music video show dancing representations of moments for hand hygiene in health care, the choreography of which all participants were invited to practice together (the correct technique for hand hygiene using antiseptic); and 3) creation of a Brazilian comic and popular musical parody with reference to the recommendation to perform the injector lateral friction with antiseptic for 30 seconds. The staff was encouraged to perform friction side injector humming the chorus of choice that lasted 30 seconds. The strategies were widely disseminated by the facilitator on all the neonatal unit shifts.

Post-implementation of the bundles

Between seven and eight months after the implementation of bundles, meetings were held with the management group and the team of all neonatal unit shifts to present the results and goals achieved.

The protocol was made available, in print and digital versions, for care and maintenance of the neonatal PICC to the members of the group and the institution, and for catheters in the electronic system (intranet) of the institution to ensure access to and dissemination of standardized practices. All methodology, instruments, and materials used in the survey were shared with the hospital infection control committee, in order to facilitate monitoring of the maintenance data related to catheter-associated infection, to conduct periodic audits of the insertion and maintenance practices of CVC, and to provide feedback to the neonatal unit.

Impact of the implementation of the bundles in insertion practices and maintenance of catheters

The changes in the practices of integration and maintenance of catheters by health professionals, measured by observations of pre-and post-implementation phases, are presented in Tables 2 and 3.

Discussion

To our knowledge, this is the first study that demonstrated the impact of Brazilian implementation of bundles on the insertion and maintenance of catheters, demonstrated by the improvement of the practices performed by professionals in a neonatal unit, and which used the conceptual model of knowledge transfer for development and implementation of the bundles.

In a multi-center study [15], the authors highlighted that in three American States where there have been major reductions in the rates of infection were the places where the team participated actively in the process of implementation of bundles in the neonatal intensive care unit (NICU), with greater credibility of the data collected and presented. This research also showed a 65% reduction in rates of bloodstream infection associated with catheter [16].

The choice of drawing up two bundles, one for insertion and another for maintenance, took into consideration the scientific evidence, but also the local context. This included: to collectively establish the goals with the consensus of the team and to examine the barriers and facilitators, promoting a realistic investigation of improvements expected by the team. For example, whereas insertion practices were much closer to the recommendations in the pre-implementation period, all targets were established at 100%, all of which were met. Other studies that used bundles [5,6,17-19] also reported setting up goals to motivate teams, but they did not describe the process to develop the goals and the values involved.

The KT conceptual framework points to some elements as essential to the successful implementation of interventions in healthcare practice, such as the selection of the evidence, the factors related to the context, and the facilitation process [20-21].

The conceptual model adopted in this study emphasizes the importance of the team's involvement with voluntary participation, considering the different knowledge and accountability of health professionals throughout the implementation process. The active participation of end-users of scientific evidence in the process of transfer of knowledge from theory to practice has been shown to be effective in promoting change [9]. In this study, there were more than 20 meetings to

discuss and practice reflection space, emphasizing the multidisciplinary involvement of unity and participation of sectors directly involved with the problem, such as the hospital infection control committee and the children's surgery staff.

The targets were not imposed by the researchers, but developed from the situational diagnosis. Reflecting on the context and the work process, the team undertook to achieve what they deemed achievable and measurable, considering the barriers and facilitators previously identified.

Evidence indicates a greater range from the adoption of two bundles, one for maintenance and another for insertion of the catheter, in addition to greater impact on infection rates with the maintenance bundle [5,22]. The same event was observed in this study; most significant changes occurred between the maintenance practices compared to the insertion of catheters, whereas adherence to the recommendations was satisfactory in both situations.

A difficulty in drafting the bundle was the lack of consensus in the literature about the skin drying time, opting for the recommendation to wait for 30 seconds before making the puncture [18,22], which introduced differences in pre-and post-implementation. Other studies on infection prevention of central line catheters also included this in their bundles [5,13,18,23-27], although they did not present pre- and post-implementation comparison of their suitability as in this study.

In relation to maintenance care of catheters, four practices were assigned to individual professional responsibility. The recommendation to “keep the infusion system closed” [15,28-31] was completely achieved by the team pre- and post-implementation of the procedure. The three other expected practices by professionals often included in other bundles were performing hand hygiene before and after handling the CVC [4-7,13,16,18,22-26,29,31-34], performing correct technique of cleansing of the hands, and carrying out friction side guns and connections for 30 seconds [4,7,15,22-23,26,28,30-31,33,35]; only the last recommendation showed no statistically significant difference when compared to the rate of inappropriateness pre-and post-implementation scripts, though it was considered a clinically important improvement in 37%.

Although common in various bundles in previous studies, the staff compliance to practices was not specifically presented in these studies, except in a multicenter study [26] in which the authors referred to limitations in the analysis by a three-month period of

basal data collection and the absence of a specific measurement of adherence to each component of the bundle [26].

Five out of the the seven CVC practice care assigned to the team had an increase in staff compliance rates when comparing the pre- and post-implementation phases ($p < 0.01$). These practices included: availability of liquid alcohol (70%) near each bed, availability of chlorhexidine on each bed, maintenance of equipment [30,36], adequate care dressing (not measured in five studies) [4,15,23,31,35], and infusion of parenteral nutrition in an exclusive catheter.

The strategy audit and feedback were used for team motivation and evaluation of the other type of used strategies. This strategy can reveal discrepancies between desired practices and those effectively performed, in addition to enabling comparisons between different practices and professionals from different institutions [37].

Several other strategies were also used to facilitate the implementation of recommended practices in bundles, based on the established goals and the barriers and facilitators appointed by the group manager. In this study, we defined barriers as any critical factor or situation between the implementation plan and the actual uptake by the parties involved that may potentially jeopardize the expected results.

The use of specific strategies is important to a specific target audience, given that interventions do not always work the same way in all circumstances for all kinds of people [38].

On the role of the group manager, carefully formed implementation science researchers explain that we need to engage key stakeholders to establish an explicit process of priorities for activities related to the transfer of knowledge [39].

The facilitator is someone who has skills and knowledge to help individuals, teams, and organizations in this process [20]. For instance, being someone respected by the team who has creativity and persuasion skills, either internal or external from the team).

Considering the KT a benchmark originated and commonly developed in international contexts that differ from Brazil, the absence of a culture of evidence-based practice and lack of continuous evaluation and feedback on the drive, the lack of professional uptime, especially by overloading of this unit's nurses in this study may have contributed to some difficulties in the process of implementing the change. However, studies on barriers and facilitators to implementation [40,41] point out that several difficulties are similar between

developed and developing countries inherent in the process of changing practices, such as the workload of the professionals and their high turnover, labor standards, gaps in knowledge and skills, and the lack of resources to finance the implementation.

Some facilitators found throughout the process also deserve to be highlighted, such as the relevance of the topic and the institutional support for the development of research, the partnerships established with some professionals (*e.g.*, managers, leadership) and with the interrelated sectors (hospital infection control committee and children's surgery), the profile of the facilitator, and the commitment and involvement of the team.

Sharing this experience in our Brazilian reality enables the dissemination and adaptation of this tool to other appropriate situations and themes. It is recommended that new studies of longer duration be conducted to assess the behavior of these long-term changes, thus contributing to the improvement of sustainability strategies, another major challenge that needs to be better exploited.

Conclusions

The steps of KT were effective in guiding the implementation of two bundles for CABSİ prevention, considering the careful selection of evidence, context-related factors and facilitation strategies. The implementation of the bundles was planned by a manager group, mediated by a facilitator and guided by goals established by the professionals.

The greatest impact occurred on catheter maintenance, seven out of eleven practices improved significantly ($p < 0.01$). The insertion of catheters had a lower impact of change due to the high adequacy indexes prior to implementation, but also showed satisfactory adherence to the recommendations.

This is the first Brazilian study to use the conceptual framework KT to elaborate, implement and evaluate the impact of bundles for central catheter in a neonatal care environment, describing in detail the implementation process. The importance of accountability and team involvement in all stages of the research is highlighted.

Acknowledgements

We thank the neonatal unit team of the institution, a crucial factor in obtaining the results presented here.

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Conflict of interests: No conflict of interests is declared.