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**Title of Manuscript:** Routine changing of intravascular administration-sets does not reduce colonization or infection in central venous catheters

**Abbreviated Title:** Prolonged intravascular administration-set use

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## **TITLE**

Routine changing of intravascular administration-sets does not reduce colonization or infection in central venous catheters.

## **ABSTRACT** (250 words)

**Objective:** To determine the effect of routine intravascular administration-set changes on central venous catheter (CVC) colonization and catheter related bacteremia (CRB).

**Design:** Prospective, randomised controlled trial

**Setting:** 18-bed ICU in a University-affiliated, tertiary referral hospital.

**Participants:** 404 chlorhexidine and silver sulfadiazine coated multi-lumen CVCs from 251 intensive care unit (ICU) patients.

**Interventions:** After ethical approval, CVCs inserted in ICU and in situ on Day 4 were randomised to have their administration-sets changed on Day 4 (n = 203) or not at all (n = 201). Fluid container and blood product administration-set use was limited to 24 hours. CVCs were removed (Day 7, not required or suspected infection), and cultured for colonization ( $\geq 15$  cfu). Medical and laboratory staff were blinded. CRB was diagnosed by a blinded intensivist using strict definitions. Data was collected on; catheter life, CVC site, APACHE II score, patient age, diagnosis, hyperglycemia, hypoalbuminemia, immune status, number of fluid containers and intravenous injections, propofol, blood, TPN or lipid infusion.

**Results:** There were 10 colonized CVCs in the set change group and 19 in the no change group. This was not a statistically significant difference on Kaplan Meier survival analysis (Effect Size = 0.09, Log Rank = 0.87, df = 1, p = 0.35). There were 3 cases of CRB per group. Logistic regression found that burns diagnosis and increased ICU stay were the only factors that significantly predicted colonization (p < 0.001).

**Conclusions:** Intravenous administration-sets can be used for 7-days. Routine administration-set changes are unnecessary before this time.

## TITLE

Routine changing of intravascular administration-sets does not reduce colonization or infection in central venous catheters.

## INTRODUCTION

Many hospitalised patients require an intravascular catheter for the administration of fluid, nutrition and medication, for intravascular monitoring or for ease of blood sampling. Intravascular catheters break the body's natural defence barrier (the skin), and so put the patient at risk of hospital-acquired infection. Catheter-related infection is devastating, with increased suffering and risk of death for patients and increased institutional costs due to the increased length and complexity of the hospital admission and associated costs. A case-controlled study observed patients with catheter related bacteremia (CRB) to have an attributable mortality of 25%, and an additional intensive care unit (ICU) stay of 6.5 days; the cost of this was calculated at U.S.\$28,690 (1994 values).<sup>1</sup> Clinicians use many strategies that are believed to minimize infection risk including the routine change of intravascular administration-sets more frequently than the catheter itself is changed.

The practice of routinely changing intravascular administration-sets is not evidence-based. Prior to the 1970s, intravenous therapy was not widespread and administration-sets seem to have been used until they were no longer required. The procedure of routine replacement of administration-sets developed in response to the early 1970s U.S. epidemic of catheter-related bacteremia, which occurred due to manufacturer contaminated intravenous fluid.<sup>2,3</sup> Despite the seeming unrelated nature to the cause of the problem, the solution of routine replacement of administration-sets and fluids every 24 hours was advocated,<sup>4</sup> and almost universally implemented.

Over the past three decades, researchers have slowly challenged the premise that daily set changes are required. Several studies have compared different time-intervals for changing the sets. Changes at 48 hours were found equi-efficacious as at 24 hours,<sup>5-8</sup> changes at 72 hours were observed to be equal to those at 48 hours,<sup>9,10</sup> or at 24 hours,<sup>11</sup> set changes at 96hrs were found equivalent to changes at 48hrs,<sup>12,13</sup> changes "between Day 4 and Day 7" found equivalent to change at Day 3,<sup>14</sup> and changes at 24, 48, 72, 96 and 120 hours found to be indistinguishable from each other.<sup>15</sup> It is interesting that all these studies were based on the assumption that routine administration-set changes prevent infection: the focus was to find an "ideal" time-interval for performing administration-set changes rather than questioning the efficacy of the practice *per se*.

The most recent Centers for Disease Control (CDC) Guidelines recognise the lack of evidence for this procedure and advise the changing of administration-sets "no more frequently than every 72 hours".<sup>16</sup> In many clinical settings this seems to have been interpreted as "change at 72 hours", although there are increasing anecdotal reports of institutions extending use of administration-sets to 7 days, motivated by the cost savings achieved.

The issue of total parenteral nutrition (TPN) and lipid administration-sets is a slightly more complicated issue than for standard solutions. The CDC advocates 24-hourly changes for TPN and lipid sets, perceiving that more frequent set changes are required than for other solutions, in order to prevent infection. Some studies have found TPN to behave no differently to other fluids,<sup>5,12</sup> or that longer intervals between set changes are associated with lower infection than more frequent changes.<sup>11</sup> One

study found a reduced infection rate with more frequent lipid administration-set changes in a neonatal population, a subgroup that may perform differently.<sup>17</sup> This study along with many others on the topic, sampled administration-set fluid but not the catheter itself, which makes assessment of the relationship between duration of administration-set use and catheter colonization or CRB impossible.

The present study examined whether routine administration-set changes, (including TPN and lipid sets), resulted in decreased colonization or infection when compared with central venous catheters that had their original administration-sets left intact for the duration of CVC usage.

## **METHODS**

### **Study Setting**

The study took place in an 18 bed ICU in a 700-bed tertiary referral hospital. It should be noted for this study, the hospital is a regional centre for burns and bone marrow transplantation. As in most Australian ICUs, the unit has dedicated staffing, both medical and nursing. The medical staff consist of full-time Intensivists, "senior registrars" (24 month appointments) and rotating registrars from disciplines of medicine, surgery, emergency medicine and anesthesiology. The ICU medical staff have sole admitting, discharge and prescribing rights. The unit has approximately 80% bed occupancy and over 1200 patients are admitted per annum with an average length of stay of just under 4 days.

### **Study Sample**

A variety of CVCs were used in the ICU prior to the study, however unit policy was standardised during the research period. The ARROWgard Blue<sup>®</sup> 3 or 4 lumen chlorhexidine and silver sulfadiazine coated CVC (Arrow International Inc, Pennsylvania, U.S.A.) was used for all catheterizations. The only exclusion to this was for patients who were known to be allergic to the catheter materials, however no such patients were admitted. Between February 1999 and January 2000, all CVCs remaining *in situ* on Day 4 (day of insertion being Day 1) were randomised into the study. A computerised random-number generator was used to assign each CVC to receive either a routine set change (experimental group) or to have the original administration-set left intact for the duration of CVC life (control group). Eligible subjects were entered sequentially and individual patients could enter the study more than once if they had multiple catheterizations. The unit of measurement was the individual catheter not the patient.

### **Catheter Care**

CVC insertion was by ICU medical staff, including Intensivists, senior registrars and registrars. Insertion was undertaken in the ICU using strict aseptic technique and always at a new skin site, with new intravenous fluids and administration-sets connected. Catheters were non-tunnelled but were secured to the skin by two sutures.

For the experimental group, set changes were performed on Day 4 at approximately 72 hrs (+/- 12 hours) post-insertion. ICU registered nurses (RNs) prepared administration-sets using an aseptic technique, involving a sterile drape and sterile gloves following a clinical (2 minute) handwash. Administration-set changes were performed using an aseptic technique of clinical handwash, sterile gloves, clean

plastic apron, sterile dressing packs, sterile drape under the connection area and chlorhexidine swabbing of connection sites prior to administration-set change.

For the purposes of this study, the administration-set was defined as all connections between the CVC and the fluid reservoir, including: intravascular tubing, fluid burettes, extension tubing, and pressure monitor transducers. Fluid reservoirs (i.e. fluid bags, bottles and syringes) were also changed at the time of administration-set change. Fluid reservoirs were additionally changed within 24 hours of opening. Administration-sets used to administer blood or blood products were discarded after each transfusion episode. However, administration-sets used for total parenteral nutrition, lipids and propofol infusions were included in the study, that is they were changed only at Day-4 or were left intact. The composition of administration-sets was not static. If a new infusion was required or an existing infusion no longer needed, then these were assembled and connected or disconnected using a non-touch technique.

All other aspects of CVC management apart from administration-set changes were equal between groups. Dressing changes (Opsite® IV3000, Smith and Nephew Medical Ltd., Hull, U.K.) were performed routinely on Day 4 for all patients and additionally if the dressing was soiled, loose or had a collection of blood beneath it. Medical staff ordered the removal of CVCs routinely on Day 7 or earlier if the patient died, did not require the CVC or was suspected of CVC infection. Medical staff were blinded to treatment group so that their decision to order catheter removal, blood or other cultures was not biased.

### **Catheter Culture**

Removal of the CVC and preparation of tip specimen was performed by ICU RNs using a clinical handwash, sterile gloves, clean plastic apron, sterile dressing pack and sterile drape. The insertion site was swabbed 5 times with chlorhexidine in ever increasing circles and allowed to dry. The stitches were cut with a sterile stitch cutter, the CVC was removed and the distal portion (approximately 3cm) was severed with sterile scissors and placed in a sterile specimen jar. CVC tips were sent to the microbiology lab for culture and speciation via semiquantitative technique.<sup>18</sup> The laboratory staff were blinded to treatment group so that the results were unbiased.

### **Data Collection**

Research nurses' monitored adherence to the protocol and collected data on microbiology results, presence of the Systemic Inflammatory Response Syndrome (SIRS),<sup>19</sup> patient demographics and other potential risk factors for CVC infection. A blinded intensivist reviewed microbiological results (catheter tip cultures, blood cultures and cultures of other sites) and SIRS using strict definitions<sup>20</sup> to diagnose the presence or absence of CRB.

### **Definitions**

A positive catheter tip culture was defined as the growth of at least one species of 15 or greater colony forming units. Catheter Related Bacteremia was diagnosed as definite, probable (types 1 and 2 combined), possible or absent using previously described definitions.<sup>20</sup> These definitions were developed to address the difficulties associated with the application of the more commonly used CDC definition of Catheter Related Bloodstream Infection (CRBSI) in situations such as the ICU, where patients are difficult to diagnose due to multiple concurrent disease processes and/or colonized sites, and unavailable or incomplete microbiological data. The "Definite"

and “Possible” categories used in this study combine to equate with the CDC definition of CRBSI, a fact that will facilitate comparison between this and other studies. See Table 1.

***Insert Table 1 here***

### **Ethical Considerations**

The study was approved by both the Hospital and the University Human Research Ethics Committees. Individual consent was waived considering the legal incompetence of patients. State legislation precluded relatives from considering legal consent, however relatives were notified of enrolment, provided with information about the study and were able to ask questions or to request their relative’s withdrawal without penalty.

### **Statistical Analysis**

Considering the varied duration of catheterization the primary analysis of colonization between groups was tested using Kaplan-Meier survival curve with Log-rank test. The distribution between groups of variables considered risk factors for catheter colonization were tested to assess for bias. Proportions were tested with chi-square. Differences in mean scores on continuous variables were tested with t-test. Logistic regression modelling was performed to analyse the influence of potentially confounding variables. A total of 29 CVCs (7.1%) were not cultured due to factors such as; catheter contaminated on removal by staff or patient, tip lost in transit to laboratory, or catheter left in situ for coronial autopsy. These were equally distributed across treatment groups (set change group n = 14, no change n = 15). All analysis was undertaken using the Statistical Package for the Social Sciences version 10.0 (SPSS®, Chicago, U.S.A.).

## **RESULTS**

### **Sample**

A total of 404 CVCs were enrolled into the study from 251 patients. Of these, 157 patients contributed 1 CVC to the study, the others having multiple catheters. There were 24,918 hours of catheter life in the set change group and 25,384 hours in the no change group. Randomisation was successful in distributing most demographic variables and risk factors for CVC infection equally between groups. See Table 2. The only statistically significantly difference between groups was for age and the number of intravenous injections. It is unlikely that these differences were clinically significant, comprising a mean difference of 5 years in age and 6 injections per CVC.

***Insert Table 2 here***

### **Colonization**

Of the 375 catheter tips cultured, there were 10 colonized tips in the set change group and 19 in the no set change group. This difference was not statistically significant (Kaplan Meier survival analysis, Log Rank = 0.87, df = 1, p = 0.3505). See Figure 1.

The 29 colonized tips belonged to 23 patients. Four patients had multiple colonized tips including two patients with two colonized tips, and two with three colonized tips.

Of these four patients with multiple colonized tips, three had other non-colonized tips in the study. Of the other 19 patients with a single colonized tip, 13 had at least one other non-colonized tip in the study. A first-catheter-per-patient analysis was also performed and found no difference in colonization between the study groups (Kaplan-Meier with Log Rank = 2.63, df = 1, p = 0.1047).

There was a significant difference in colonization rates by catheter site. Subclavian lines were colonized in only 5.0% of cases, jugular lines in 9.4% of cases and femoral lines in 20.8% of catheters (chi-square 14.48, df = 2, p = 0.001). There were also statistically significant differences in colonization by diagnostic group (chi-square 39.15, df = 3, p < 0.001) with neurological patients having the lowest (zero) incidence and burns patients the highest (29%). Surgical/trauma and medical patients had more moderate levels at 5% and 7% respectively.

***Insert Figure 1 here***

### **Catheter Related Bacteremia**

Of the 404 patients, there were 3 cases (1 definite, 1 probable and 1 possible) of CRB in the experimental (set change) group and 3 (2 probable and 1 possible) in the control (no change) group. Implicated organisms were from the *Acinetobacter*, *Staphylococcus*, *Pseudomonas*, *Enterobacter* and *Klebsiella* species. The difference in survival from CRB rates between groups was not statistically significant (Kaplan Meier with Log Rank test, p = 0.862). See Figure 2

***Insert Figure 2 here***

### **Logistic Regression Model**

Bivariate analysis was performed to examine significant associations between catheter colonization and a range of risk factors. Factors that were not associated with colonization of the catheter tip included: APACHE II score on ICU admission, number of intravenous fluid bags infused, hours of catheter life, medical seniority of catheter inserter, number of lumens, immunocompromised status, hyperglycemia and propofol, total parenteral nutrition, or lipid transfusion,

The following factors were found to be significantly associated with colonized catheters on bivariate analysis: age, burns diagnosis, ICU days on catheter insertion, hospital days on catheter insertion, APACHE II on day of insertion, blood transfusion, hypoalbuminemia, removal for suspected CRB, site of catheter, and subsequent catheters in multiply catheterized patients.

To test these risk factors in a multivariate model, a forward step-wise logistic regression was conducted. Only two risk factors entered the model; burns diagnosis (OR 6.845, 95%CI 2.96 - 15.83, p < 0.001) and increased ICU days on catheter insertion (OR1.080, 95%CI 1.035 - 1.127, p < 0.001).

## **DISCUSSION**

This study did not find a statistically significant difference in colonization or CRB rates between catheters whose administration-sets were routinely replaced on Day 4 and those whose administration-sets were not replaced at all. The study involved central venous catheters from ICU patients, including burns patients, immunosuppressed patients and those receiving TPN and lipid therapy. These groups have been

identified in the literature as at high risk of catheter colonization and infection.<sup>8,21,22</sup> Routine changing of administration-sets was of no benefit to this high-risk sample and as such, it is unlikely it would have any effect in lower risk populations such as ward patients or other types of intravascular catheters such as arterial lines.

The sample size had 80% power to detect an effect size on colonization of 0.14 at an alpha of 0.05. The effect size observed was 0.09, a small effect size as per Cohen's criteria.<sup>23</sup> This equates to the observed incidence of 5.3% colonization in the set change group and 10.2% in the no set change group, a difference that was not statistically significant. It is possible that a larger sample may have detected a significant difference, however it could only have been at most at a slightly larger effect size, still in the range of small effect, that is, in the realm of 0.10 - 0.13, and it is questionable whether this would be of clinical significance. It must be remembered that colonization in itself is harmless and relatively common, with incidence quoted in the literature much higher than the data reported here in either group. A meta-analysis of 12 studies assessing the efficacy of the chlorhexidine-silver-sulphadiazine catheters (identical to those used in this study) found the colonisation rate to be a mean 16.2% with a range of 0 - 39.7%.<sup>24</sup> Some level of colonisation should be considered unavoidable, although at what level is debatable. A study that cultured CVCs immediately after insertion found that 16% were already colonized despite skin disinfection and aseptic insertion technique.<sup>25</sup> If an acceptable or at least an average colonization rate is at around the 16% rate, then any potential significant difference related to administration-set changes that would have been observed in a larger study would be unlikely to be of clinical significance. Vitaly, colonization was a surrogate endpoint for CRB due to the statistical difficulties of using the infrequently diagnosed CRB, and the known potential for colonized catheters to progress over time to infection.<sup>22,26</sup> In interpreting the results of this study, it is important to note that CRB is the actual phenomenon of interest and that the incidence of this diagnosis was identical (1.5% of catheters or 3 cases per 1000 catheter days) in the two groups. This incidence is at the lower end of the reported figures in the literature.<sup>27</sup>

Colonization incidence was 10.4 per 1000 catheter days in the experimental group and 20.1 per 1000 catheter days in the control group, a difference that was not significant even on crude analysis (OR experimental group 0.51, 95%CI 0.24 - 1.09,  $p = 0.34$ ). It is important to note that the primary statistical analysis used was the more sophisticated survival modelling, which accounted for not only the magnitude of the incidence of colonization/CRB between groups but also how long the implicated catheter had been in situ for when the colonization/CRB occurred. This is an important consideration in this type of study; for example a catheter that becomes colonized on Day 4 is of greater concern than one that is colonized on Day 7.

There have been 16 studies into the appropriate duration of administration-set use.<sup>5-15,17,28-31</sup> These studies have been undertaken in a variety of populations and catheter types, and all, except one,<sup>17</sup> found an equal or a reduced infection risk the longer that administration-sets were left unchanged. The one study that did find benefit had somewhat conflicting results in that a reduced contamination rate in the fluid itself was found after 72 hour changes versus 24 hour changes, however no difference was found in infusate related bacteremia between the groups (catheter colonization rates were not reported).<sup>17</sup> Interestingly, all research studies to date have focussed on the identification of an optimal time-point for routine administration-set replacement to occur; that is, they have assumed that one exists.<sup>5-15,17,28-31</sup> Occasionally it is noted that there may not be an ideal time-point, and the practice may have no effect at all.<sup>9,28</sup> Our study is important, as it is the first to address this question, by having an experimental group who were not subjected to administration-set replacement at any time-point (in this case, over the 7-day catheter life). The



practice of routinely replacing administration-sets has become entrenched in clinical ritual over the last three decades and attempts to reduce or disband the practice are difficult despite the absence of definitive evidence to support it, and a growing body of evidence to suggest that it is ineffective. The 1996 CDC guidelines are frequently misquoted to support the procedure when they do not recommend the procedure *per se*, merely stating that it should occur “no more frequently than at 72 hour intervals”.<sup>16</sup>

The finding of this study, that routine administration-set changes had no benefit, seems to be congruent with the pathogenesis of catheter colonization. The four potential routes of catheter colonization have been identified as the skin site, hematogenous seeding from distant sites, a contaminated catheter hub or contaminated intravenous fluid.<sup>22,32</sup> Of these, colonization via the skin site is recognised as the dominant route of colonization for short term (in situ < 10 days) catheters,<sup>33</sup> and may occur as early as at catheter insertion, that is, before the administration-sets are even connected.<sup>25</sup> However, skin site colonization as well as colonization due to hematological seeding, could not possibly be prevented by administration-set changes, as the administration-set does not involve these pathways. In contrast, replacement of the administration-set could theoretically influence catheter hub and intravenous fluid contamination. Traditionally it has been assumed that replacement of sets would decrease circuit contamination however it seems equally, if not more likely, that the potential for contamination could be increased. Administration-sets connect both to the catheter hub and to intravenous fluid containers; routine replacement involves additional manual handling of these structures and a break to the circuit, thus providing an opportunity for microorganism entry.<sup>28</sup>

Extrinsic (post-manufacturer) intravenous fluid contamination infrequently occurs and colonization of the fluid does not necessarily progress to colonization or infection.<sup>16</sup> The risk of contamination of the fluid container may be different to the administration-set proper (the “giving sets”, burettes, connection tubing etc) as it involves a larger volume of more static fluid, in contrast to the small volume dynamic fluid in the set itself. It seems logical that the less times the circuit is disconnected to attach a fluid container, the lower the infection risk, however it is unclear from many of the previous studies into the duration of administration-set use, whether or not the intravenous fluid container was considered part of the administration-set and tested for prolonged use. The CDC gives no recommendation for the hang-time of intravenous fluids stating that this is an unresolved issue, except for TPN and lipid therapy which it advises should be completed within 24 and 12 hours respectively.<sup>16</sup> In this study we replaced all intravenous fluid containers within 24 hours of opening so as to isolate the effect of prolonged use of the administration-set proper, from that of the intravenous fluid container.

The results of this study are not surprising considering the clinical approach to administration-set integrity during the total catheterization period instead of merely at the routine set change. Administration-set configurations are not static throughout the catheterization period, but rather are manipulated frequently in the ICU environment (to add, remove or reconfigure infusions, to replace a fluid container or to give a medication). The standard techniques used for these manipulations should involve handwashing or at least hand alcohol solution and the set should be decontaminated with chlorhexidine, iodine or 70% alcohol before and after the set manipulation.<sup>16,26</sup> However, in the real world, the techniques used by staff are often divergent and may be less than aseptic.<sup>8</sup> Adherence to rigorous sterile technique on insertion and at every manipulation of the circuit would probably have a more reliable effect on infection rates than a reliance on replacing the administration-sets at routine intervals

in the belief that this will “resterilise” the circuit after the questionable techniques used in between.<sup>8,34</sup>

Before applying the results of this study to other populations, there are some important points to consider. It should be noted that the study design involved the removal of administration-sets used to deliver blood products once the transfusion was complete (< 24 hours) and the results therefore do not support extending the duration of use of blood product administration-sets. Other factors to consider in applying the results of this study include the study population of antimicrobial CVCs which are known to reduce colonization over plain catheters,<sup>24,33,35</sup> but may not be as effective as antibiotic catheters, especially in longer term CVCs in situ for greater than 7 days.<sup>36-38</sup> The caution of previous commentators on the issue of extending administration-set use should be noted; namely that results from studies that are undertaken in Western, research-oriented, tertiary-care centres (such as ours) may be influenced by a more meticulous standard of catheter care that may not be achieved in other settings.<sup>39,40</sup> It is possible that routine change of administration-sets may have an effect in other settings although it is difficult to imagine that the scale of an effect could be even close to that achievable by simple techniques such as aseptic approach and stringent handwashing, or at a more sophisticated level, the use of antimicrobial catheters.

The results of the study suggest that routine administration-set changes are ineffectual at any time point, however until a multi-centre, randomised controlled trial confirms these results, or assesses use beyond one week, it would be prudent to limit administration-set use to 7 days rather than for an unlimited time-frame. The study included catheters in situ for 52 - 196 hours (mean 124.5 hours), with a significant proportion (25%) removed on or after catheter Day 7. The results indicate that routine administration-set changes are unnecessary for catheters in situ for approximately one week, however the effect after this time has not been assessed. The ICU policy was to remove CVCs on Day 7, however 12 study catheters were in situ for a longer period. Of these, 3 were in the routine set change group and were not colonized, compared with 3 colonized lines out of the 9 catheters in the no-change group. The 3 colonized lines were not associated with CRB diagnosis. Due to the small amount of catheters subjected to this timeframe, no conclusion can be drawn from this observation. It may indicate a trend to effectiveness of administration-set changes at the Day 7 time point, but more probably reflects the known tendency of catheters to be colonized after this length of time.<sup>26,38,41</sup>

An issue that is often overlooked in this area is the effect of extended use on the actual physical condition of the administration-set. Recent data on the testing of administration-sets for 7 days of continuous use found them to remain accurate and in good physical condition.<sup>42</sup> Beyond, this time, the durability of the materials is unknown. From an infection perspective, this study is the third to evaluate, and support, administration-set usage for 7 days. A study by Chen et al, to date only published in abstract form, reported no difference in colonization rates of 332 CVCs in a general ICU whose administration-sets were randomly replaced at 72 or 168 hours (1 week).<sup>43</sup> Raad, Hanna and colleagues studied 512 oncology patients whose CVCs were randomised to have the administration-sets replaced either within 3 days or between 4 and 7 days of placement.<sup>14</sup> The study design resulted in only a small proportion of the sample having administration-sets used for 7 days (approximately 25). Catheter colonization rates were not reported, however no statistically significant difference in infusate-related bacteremia (IRB) was found between the groups and it was noted that all patients with IRB were receiving interleukin-2, a medication not used in our own study group.

Routine administration-set changes are costly to perform at up to A\$300 per procedure in terms of equipment alone. Extension of administration-set usage duration to 7 days would result in significant cost savings, less environmental waste and allow nursing time to be redirected to other patient care, education or research activities. The exact nature of current practice is unknown but varies greatly. In a survey of Australian, U.S. and Canadian hospitals, approximately half were changing administration-sets < 96 hourly, yet 22% were already using the sets for one week (Unpublished data, Rickard C, Ph D Candidate, June, 2000).

The ICU environment attracts staff who enjoy a technological and highly procedural environment. A Heideggerian hermeneutic study asked what the meaning of caring in the intensive care unit was to nurses and reported one of the major themes as “being busy”.<sup>44</sup> The complex performance of a routine administration-set change (colloquially termed a “line change”) has attained the status of a ritual and as such is psychologically difficult to reduce or disband, perhaps due to health care professionals feeling that “doing something” must be more effective than not doing it. The evidence based practice movement seeks to overcome ritualistic and historically based care with the implementation of care that is scientifically proven to be effective. The results of this study suggest that evidence based practice will be achieved by extending intravascular administration-set use to 7 days and for future research to evaluate longer timeframes.

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## **Tables**

**Table 1**  
**Definitions of Catheter Related Bacteremia<sup>20</sup>**

Findings	Definite CRB	Probable CRB (Type 1)	Probable CRB (Type 2)	Possible CRB
Catheter Tip	+	+	+	-
Blood culture	+	+	-	+
SIRS with defervescence	+/-	+/-	+	+
Colonization at other sites	-	+	-	-
Infection at other sites	-	-	-	-

Catheter related bacteremia: CRB, Systemic inflammatory Response Syndrome: SIRS,  
Positive culture result: +, Negative or missing result: -

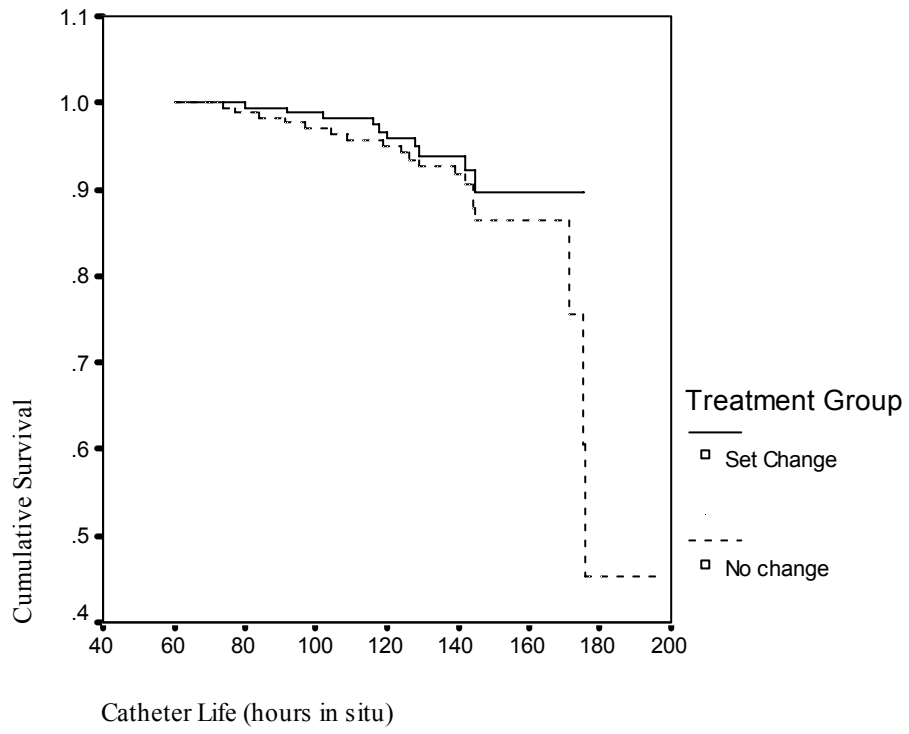
**Table 2**  
**Comparison of experimental (routine administration-set change) and control (no administration-set change) groups**

	Set Change	No Set Change	p value
Hours in situ per CVC (mean +/- SD)	122.75 (26.81)	126.29 (29.59)	NS
Male (n)	120	133	NS
Age (mean years +/- SD)	55.06 (18.66)	49.78 (19.79)	0.006
APACHE II admit (mean +/- SD)	20.11 (6.74)	20.22 (7.25)	NS
APACHE II insert (mean +/- SD)	17.46 (6.78)	17.88 (7.29)	NS
ICU days at insertion (mean +/- SD)	6.04 (7.67)	6.03 (6.47)	NS
Hospital day at insertion (mean +/- SD)	7.95 (9.33)	9.84 (12.05)	NS
Site - subclavian/jugular/femoral (n)	139/37/24	138/30/31	NS
Fluid bag changes (mean +/- SD)	55.13 (28.84)	59.23 (31.54)	NS
Injections through set (mean +/- SD)	53.74 (27.49)	59.69 (28.37)	0.033
Immunocompromised (n)	7	15	NS
Hypoalbuminemic (n)	64	69	NS
Hyperglycemic (n)	4	3	NS
Propofol Transfusion (n)	66	66	NS
TPN Transfusion (n)	36	30	NS
Blood Transfusion (n)	107	108	NS
Lipid Transfusion (n)	36	31	NS
Lumens – triple/quadruple (n)	195/8	192/9	NS
Inserted by registrar	120	131	NS
Reason for CVC removal (n)			NS
Routine (Day 7)	94	94	
Not required	59	62	
Suspected CRB	21	16	
Patient died	17	15	
Malfunction	7	10	
Other	5	4	
Diagnosis			NS
Medical	66	82	
Neuro	51	39	
Emergency Surgery	37	25	
Burns	25	28	
Trauma	17	20	
Elective Surgery	7	7	
Catheter order number			NS
First	126	125	
Second	45	48	
Third	21	17	
Fourth or more	11	11	

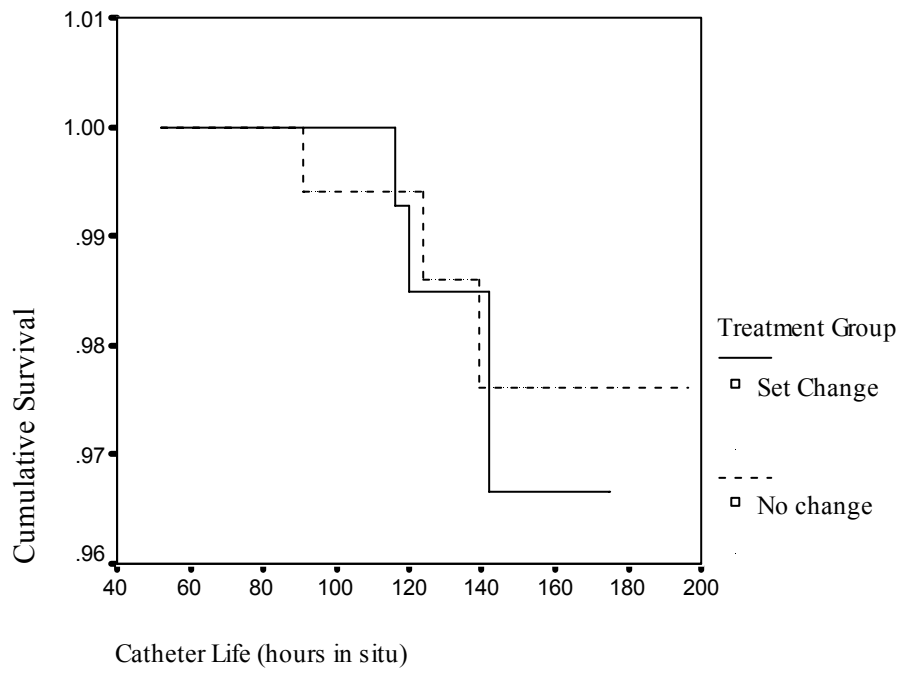


**Figures**

**Figure 1.**



**Figure 2.**



## **Figure Legends**

### **Figure 1**

Survival curve for catheters to remain free of colonization by treatment group

### **Figure 2**

Survival curve for catheters to remain free of catheter related bacteremia by treatment group