CENTRE FOR HEALTHCARE INNOVATION

CHI Learning & Development System (CHILD)

Project Title

Battling the Bugs: Reducing Early Catheter-related Bloodstream Infection in Haemodialysis Patients

Project Lead and Members

- Yeo See Cheng, Deputy Head & Consultant, Renal Medicine / Renal Unit
- Chan Siew Mie, Senior Nurse Manager, Renal Medicine / Renal Unit

Organisation(s) Involved

Tan Tock Seng Hospital

Project Period

Start date: 03-2016

Project Category

Clinical Improvement, Safety, Care Redesign, Quality Improvement

Keywords

Tan Tock Seng Hospital, Clinical Improvement, Patient Safety, Quality Improvement, Care Redesign, Care & Process Redesign, Safe Care, Tunnelled Dialysis Catheter, Blood Stream Infection, Renal Failure, Long-term Haemodialysis Improvement Tools, Macro Flowchart, Micro Flowchart, Affinity Diagram, Cause and Effect Diagram, Pareto Chart, Run Chart, Plan-Do-Study-Act, Renal Medicine, Clinical Practice Improvement Project, Effective Patient Education, Chlorhexidine Skin Wash, Intravenous Antibiotics Prophylaxis, Cost Savings.

Name and Email of Project Contact Person(s)

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Asian Hospital Management Awards 2017

PATIENT SAFETY

(Projects or programs to keep a patient SAFE, such as use of right equipment, infection control, minimize slips and falls and prevention of sentinel events.)

This award is for the hospital that introduced an outstanding project for the monitoring and assurance for safety in the diagnosis, and delivery of care. Projects for the reporting, deliberation, management, and prevention of Sentinel Events like wrong site surgery are included as part of this category. Medication errors, infection control are included. More weight is given to how much the project or program improved patient safety and if there are measurements to back this up. In other words, the judges will particularly look at the percentage of improvement. Was there therapeutic error reduction?

Complete All Information Below:

Project Title (Maximum 256 Characters):

Battling the Bugs: Reducing Early Catheter-related Bloodstream Infection in Haemodialysis Patients

Date Project Started (Maximum 128 Characters) (i.e. May 24, 2015):

Mar 15, 2016

Department Name (Maximum 256 Characters):

Renal Medicine / Renal Unit

Names of Key Staff Involved in this Project (Maximum 512 Characters) (Separate names with comma):

Yeo See Cheng (Renal Medicine), Chan Siew Mie (Renal Unit), Timothy Koh Jee Kam (Renal Medicine), Benjamin Khoo Zhi En (Renal Medicine), Jiang Nan (Ward 9A), Ooi Swee Ling (Renal Unit), Pua Uei (Intervention Radiology), Gabrielle Chia Jia Min (Infection Control), Koh Zhi Min (Clinical Standards and Improvement), Adrian Liew Seng Teck (Renal Medicine)

Details of Team Composition

Leader

1) Yeo See Cheng, Deputy Head of Department & Consultant, Renal Medicine
2) Chan Siew Mie, Senior Nurse Manager, Renal Unit

Member

1) Timothy Koh Jee Kam, Consultant, Renal Medicine
2) Benjamin Khoo Zhi En, Senior Resident, Renal Medicine
3) Jian Nan, Nurse Clinician, Ward 9A
4) Ooi Swee Ling, Assistant Nurse Clinician, Renal Unit
5) Pua Uei, Senior Consultant, Intervention Radiology
6) Gabrielle Chia Jia Min, Senior Staff Nurse, Infection Control
7) Koh Zhi Min, Executive, Clinical Standards and Improvement

Sponsor

1) Adrian Liew Seng Teck, Head of Department & Senior Consultant, Renal Medicine

1. **Provide some background as to how the project originated e.g. what problem/opportunity were you faced with. (Maximum number of words – 350)**

Tunnelled Dialysis Catheter (TDC) remains an important vascular access in patients undergoing long-term Haemodialysis (HD). More than 80% of patients with incident end-stage renal failure commenced HD with a TDC and after 4 months, 53% of these patients were still receiving HD via a TDC.[1]

Infections remain one of the top causes of hospitalisations and deaths in HD patients and TDCs are commonly associated with infectious complications, including Catheter-related Blood Stream Infection (BSI). Catheter-related BSI is one of the most serious complications in HD patients and leads to increased mortality and morbidity. Morbidity includes metastatic infections, such as infective endocarditis, osteomyelitis and deep tissue infections. Consequently, these patients require prolonged treatment, additional invasive procedures, increased length of stay, ICU admission and/or additional hospitalisation.

In addition to poorer patient outcomes, each episode of catheter-related BSI is associated with significant increase in healthcare costs.[2,3]

In our centre, between 2014 and 2015, there was an average of 11.5 episodes per year of catheter-related BSI in HD patients that occurred early after a newly inserted TDC, representing an average rate of 1.9 cases of BSI per 100 catheters inserted. In those cases, the median time from TDC insertion to positive blood culture was 72 hours and 80% occurred within the first two weeks. Both gram-positive and gram-negative organisms were involved in these episodes – methicillin resistant *Staphylococcus Aureus* (MRSA) was the leading causal organism, followed by *Pseudomonas aeruginosa*.

Current literature is focused on long-term maintenance of the TDC but little is known about the prevention of catheter-related BSI during TDC insertion or in the early period immediately post TDC insertion.

Project's objective is to identify and address the causes of early catheter-related BSI in HD patients.

[1]USRDS Annual Data Report Volume 2. Incidence, prevalence, patient characteristics and modality. Am J Kidney Dis 2013; 61:e215-28.
[2]Curtis LT. Prevention of hospital-acquired infections: review of non-pharmacological interventions. J Hosp Infect 2008; 69:204-19.
[3]Clancy M *et al.* Active screening in high-risk units is an effective and cost-avoidant method to reduce the rate of methicillin-resistant Staphylococcus aureus infection in the hospital. Infect Control Hosp Epidemiol 2006; 27:1009-17.

2. Describe what was required to address the aforementioned problem/opportunity. Outline what your targets/goals were. Also, provide an overview of the team that was put together to undertake this. (Maximum number of words – 350)

Aim

The aim of this clinical practice improvement project is to reduce early catheter-related BSI in HD patients with newly inserted tunnelled dialysis catheter by 80% over a six-month period in Wards 9A and 11A (Renal Wards).

Inclusion Criteria

All HD patients in Wards 9A and 11A (Renal Wards) undergoing insertion of TDC between April 2016 and December 2016 were included in this project.

Methodology

Quality Planning Tools (which include Macro/Micro Flowchart, Affinity Diagram, Cause and Effect Diagram, Pareto chart and Run chart) were used to diagnose the problem, identify root causes, plan interventions and determine if changes led to improvement.

Primary Outcome

The primary outcome (outcome measure) is the rate of early catheter-related BSI in all newly inserted TDC over the same period (expressed as number of catheter-related BSI per 100 catheter inserted).

The following criteria are used to define catheter-related BSI:

- Newly inserted tunnelled dialysis catheter;
- Positive blood culture (blood stream infection) *after* insertion of tunnelled dialysis catheter before the patient's discharge from hospital;
- Onset of clinical signs and symptoms and positive blood culture *after* insertion of tunnelled dialysis catheter;
- No other obvious source of infection clinically.

The rate of early catheter-related BSI was compared between pre-intervention observation period (April 2016 to June 2016) and post-intervention observation period (July 2016 to December 2016).

Details of Team Composition

Leader

1) Yeo See Cheng, Deputy Head of Department & Consultant, Renal Medicine
2) Chan Siew Mie, Senior Nurse Manager, Renal Unit

Member

1) Timothy Koh Jee Kam, Consultant, Renal Medicine
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3. Outline the steps or stages of the project and how these were executed by the team. (Maximum number of words – 300)

Root Cause Analysis

Based on the two recognised paths of microbiological infiltration (extra-luminal and intra-luminal) potentially leading to catheter-related BSI, the skin is identified as an important site of potential intra-luminal microbiological contamination during insertion and that the exit site represents a potential source for extra-luminal microbiological contamination.

Therefore, the following were identified to be the main causes resulting in early catheter-related BSI:

(A) Poor dialysis catheter care by patient
(B) Inadequate skin preparation before dialysis catheter insertion
(C) Lack of prophylactic antibiotics during dialysis catheter insertion

Interventions

Based on the root causes, the team rolled out these interventions progressively:

(A) Improving patient education process and material on dialysis catheter care
- Education on care of TDC *before* TDC insertion
- Message reinforced in Ward 9A, 11A and Renal Unit *after* insertion
- Synchronised message from Ward 9A, 11A and Renal Unit
- Show pictorial illustrations for clarity [Picture 1]

(B) Chlorhexidine skin wash and daily change of linen for five days in preparation for dialysis catheter insertion for all patients; Nasal decolonisation of MRSA via topical mupirocin for MRSA colonisers

(C) Intravenous antibiotics (cefazolin or vancomycin) prophylaxis during dialysis catheter insertion; Topical antibiotics (gentamicin) prophylaxis to exit site post insertion

In our PDSA (Plan-Do-Study-Act) cycle, the following were introduced to refine the interventions:

a) Checklist to ensure that interventions were reliably prescribed prior to TDC insertion [Picture 2]
b) Education material was updated further, based on patients' and staff feedback with greater emphasis on pictorial information as a means to overcome barriers of language and medical jargon
c) Documentation of patient education to achieve coordination and synergy between Wards and Renal Unit
d) Chlorhexidine skin wash and nasal decolonisation for MRSA (if applicable) started earlier to ensure adequate time to complete interventions before the procedure

4. Demonstrate the results of the project and how this improved patient safety. Present quantifiable information such as before and after measurements and percentage improvement. (Maximum number of words – 200)

(A) Primary Outcome

The baseline catheter-related BSI from April 2016 to June 2016 was 4.4%.

Following the implementation of the interventions, there was an 86% decrease in rate of dialysis catheter-related BSI, from 4.4% to 0.6%.

The absolute number of cases decreased from 4 cases in 90 TDC insertion over three months (pre-intervention) to 1 case in 166 TDC insertions over six months (post-intervention) [Figure 1].

(B) Cost Savings

In decreasing the rate of catheter-related BSI, this project also resulted in substantial cost savings. As an illustration, each episode of catheter-related MRSA bacteraemia is estimated to have a direct increased cost of $5,645.81 to the patient, arising from increased length of stay and additional procedures [Table 1]. Given that the interventions implemented cost $53.52 per patient and assuming 50 interventions are necessary to prevent one episode of bacteraemia (historical infection rate of 1.9% and 600 new catheter insertions per year), the cost savings per episode of catheter-related BSI avoided is $2,969.81 and the annual cost savings is estimated to be $34,152.82. The actual additional marginal healthcare cost of catheter-related BSI is likely to be higher (as mentioned) and it is expected that the healthcare cost savings is substantial.

5. Please give any other information, including third party testimonial regarding your project which you think would help convince the judges that this project (or program) should win this category. (Maximum number of words – 300)

Patient Survey (Pre-Intervention)

In addition to our root cause analysis, patients' concerns and feedback were sought in a small group survey.

In particular, 60% of patients felt that existing patient education was easy to understand but required reinforcement as it was difficult to remember all information. 20% felt the information

presented was adequate but text-heavy. Another 20% felt that it was too narrowly focused and there was no overview on TDC insertion and care.

Staff and Patient Feedback (Post-Intervention)

Ward and Renal Unit staff reported that the interventions were easy to understand and implement. Introduction of an intervention checklist facilitated timely application of the appropriate intervention. The most common concern was related to barriers preventing effective patient education – language barrier, patients' poor understanding and lack of time for sufficient explanation.

Patients generally found the education material easy to understand and remember. Some patients commented that chlorhexidine skin wash caused dry skin but appreciated that it is important and skin dryness can be mitigated by application of skin moisturiser after chlorhexidine bath.

Sustaining and Spreading

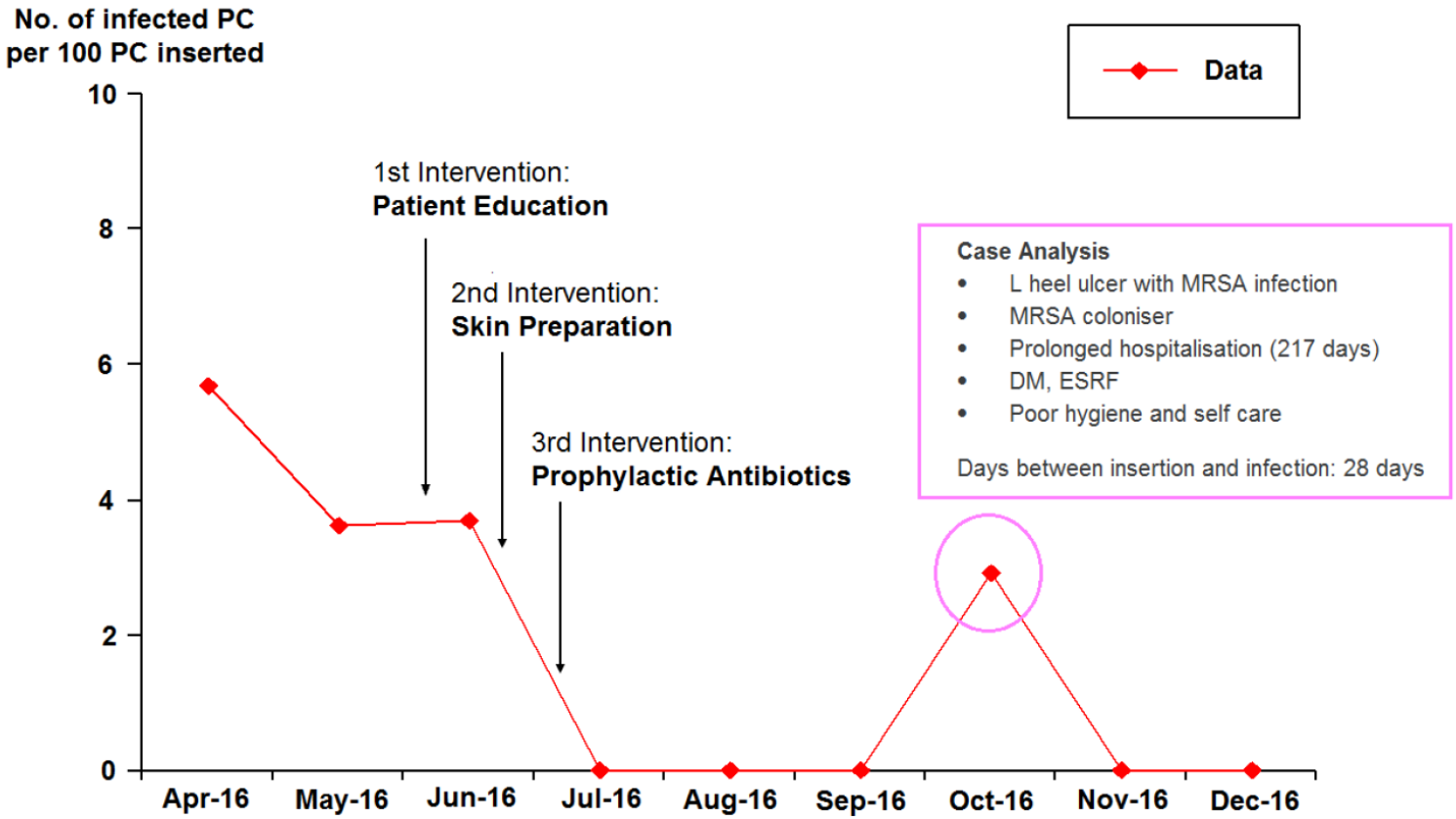
The project has expanded to include a wider group of patients requiring TDCs in our centre. Extended data collection and analysis will be performed to better evaluate the efficacy of the interventions. There are also plans to evaluate the relative efficacy of different interventions so as to identify interventions that are key to improving outcome measures and the most efficient and cost-effective method in preventing early catheter-related BSI.

Meanwhile, continual efforts to refine and simplify standardised protocol and intervention checklist (e.g., preparation before/during insertion of TDC) will remove provider-related variability and improve reliability of applying required processes and interventions.

Conclusion

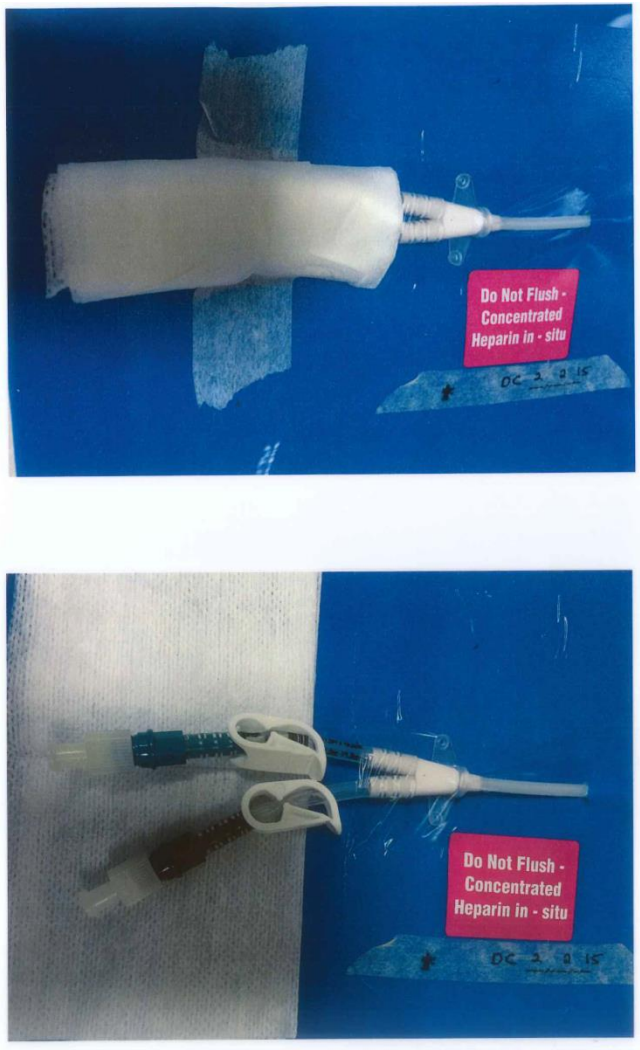
Our quality improvement project, in adopting a bundle of catheter care interventions, resulted in a marked lower rate of early catheter-related BSI in HD patients.

Appendix



There were four episodes of dialysis catheter-related BSI in the three months preceding the interventions (4.4 episodes per 100 catheter inserted) and one episode (October 2016) post-interventions (0.6 episodes per 100 catheter inserted).

Figure 1: Runchart of Dialysis Catheter-related Blood Stream Infection (BSI) Pre-Intervention and Post-Intervention



(1) Do Not Flush - Concentrated Heparin In-Situ

(2) When to Seek Immediate Medical Attention

(3) Proper Taping while Showering

Picture 1: Photo Illustration of Patient Education Process & Material on Dialysis Catheter Care Examples

Tunnelled dialysis catheter insertion checklist

Patient's label

Ward _____ Bed _____

Drug allergy _____

MRSA: YES / NO

Catheter insertion date: _____

Pre- dialysis catheter insertion

1. Chlorhexidine bath/ sponging (Please tick if it's done)
2. Order Mupirocin 2% nasal ointment TDS for MRSA cases
   (remarks: to indicate as CPIP Protocol)

	Bath/ Sponging	Change of Linen	For MRSA Mupirocin 2%
Day 1			
Day 2			
Day 3			
Day 4			
Day 5			

Day of tunnelled catheter insertion

For all cases

1. Prepare gentamicin cream to IR
2. Prepare IV cefazolin 1g to IR UNLESS patient has MRSA OR penicillin allergy

(To ensure that medication are ordered in the E-IMR)

YES	NO	N.A

For patients with MRSA swab positive or patients with penicillin allergy, to start IV vancomycin 2hours upon receiving call from IR in the ward

YES	NO	N.A

After Tunnelled catheter inserted

To Bring topical gentamicin cream to renal unit/AHU when patient goes for dialysis

Picture 2: Tunnelled Dialysis Catheter Insertion Checklist