Clinical Effectiveness of 4% tetrasodium EDTA as a routine non-antibiotic antimicrobial lock solution in central venous access devices of hemodialysis and TPN patients against the TripleThreat™: An 18-month Canadian experience.

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BACKGROUND INFORMATION

The ideal catheter lock solution should be able to prevent the occurrence of the TripleThreat™ of clot, bacterial colonisation and biofilm formation. Providing an effective barrier for the inside of central venous access devices (CVADs) must be part of the multimodal approach to decrease the risk of catheter related complications such as catheter related bloodstream infections (CRBSI) and occlusions. However, this lock solution should be effective at knocking out all three interrelated threats (see figure above). The *in vitro* effectiveness of a novel non-antibiotic antimicrobial solution of 4% tetrasodium EDTA (T-EDTA) was confirmed against biofilms formed by clinically relevant bacteria and fungi. The anticoagulant property of EDTA is well known and trusted.

OBJECTIVE

The objective of this study was to collect post approval safety and efficacy data from the use of an approved 4% T-EDTA lock solution in Canadian patients compared to the current standard of care in hemodialysis and total parenteral nutrition (TPN) patients.

MATERIALS AND METHODS

Hemodialysis and TPN patients with CVADs were selected across Canada according to their high risk of CRBSI and alteplase (r-TPA) use. This criteria was necessary to show whether a difference in these clinical endpoints would make a significant clinical and economical impact on the patient and for hospitals in a short period of time. A Return on Investment (ROI) model previously validated by a third party expert was used to show the financial impact of using the Canadian approved 4% T-EDTA solution (KiteLock 4% Sterile Catheter Lock Solution) versus the current standard of care. Before and during data were collected by study nurses.

TABLE 3 – Return on Investment (ROI) example for TPN patients – A Financial Case for Change

Patient Population: Total Parenteral Nutrition (TPN) Providence Health, BC

Number of Patients: 24 Time Period: 18 months

Total number of patients included [24], product used [saline/heparin/taurolin], and associated number of locks

Standard of Care Catheter Lock Solution	# of patients	# of locks for 18 mths
Saline, heparin, taurolin	24	12960

Now lock per patient per day

Pre-KiteLock™

Product spend for 24 patients on standard of care catheter lock solution

Standard of Care Catheter Lock Solution	# of locks	Per Unit Cost	Total Cost for 18 months
Saline (2 patients)	1080	\$0.48	\$518.40
Heparin (12 patients)	6480	\$0.52	\$3,369.60
Taurolin (10 patients)	5400	\$10.78	\$58,212.00
	12960		\$62,100.00

Additional spend for 24 patients due to catheter related complications

Catheter-Related Complications	No of each	Per Unit Cost	Cost of Catheter Complication
Cost of blocked catheters			
Alteplase/CathFlo	11	\$68.00	\$748.00
Line Replacement	19	\$220.00	\$4,180.00
Cost of Infections			
Number of catheter related Infections	16	\$15,702.40*	\$251,238.40
			\$256,166.40

Hence, the total cost associated with treating the 24 TPN patients using "conventional methods" is \$318,266.40 for 18 months.

*Validated by third party Canadian Health Economist

Post-KiteLock™ Implementation

Product spend for 24 patients on new innovative catheter lock solution

Replacement Product - KiteLock™	# of locks	Per Unit Cost	Total Cost for 18 months
	12960	\$5.50	\$71,280.00

Cost to treat complications post-KiteLock implementation among the 24 patients

Catheter-Related Complications	No of each	Per Unit Cost	Cost of Catheter Complication
Cost of blocked catheters			
Alteplase/CathFlo	0	\$0	\$0
Line Replacement	6	\$220.00	\$1,320.00
Cost of Infections			
Number of catheter related Infections	8	\$15,702.40*	\$125,619.20
			\$126,939.20

Hence, the total cost associated with treating the 24 TPN patients using KiteLock™ is \$198,219.20 for 18 month period.

Using KiteLock™ achieved:

- ✓ 100% reduction in alteplase use
- ✓ 50% reduction in central line associated blood stream infections
- ✓ \$120,047.20 financial savings in 18 months (estimated \$80,031 in one year) in CAD

Financial Return On Investment for Organization:

Expenditure per month for standard/current catheter lock solution	\$3,450.00
Savings per month Post Kite-Lock Implementation	\$6,669.29
Number of Months to achieve a Return on Investment	0.5

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RESULTS

Canadian data collected over the last 18 months show both a clinically relevant decrease in CRBSI and alteplase use when the standard catheter lock solution (4% sodium citrate for hemodialysis (Table 1); taurolidine, heparin and saline for TPN patients (Table 2)) was replaced by 4% T-EDTA. The most frequent use of this lock solution was once a day in TPN patients with no safety concerns. Hypocalcemia or bleeding episodes were not observed with its use over time. ROI was positive for all hospitals. Table 3 is an example of a Financial Case for Change.

TABLE 1 - Summary of hemodialysis beta evaluation June 2017-April 2018: 18 month Canadian experience with 4% Tetrasodium EDTA lock solution										
Hospital/Centre	Province	Start date	Patient population	Number of patients	Duration of evaluation (weeks)	Percent reduction in alteplase doses	Percent reduction in CLABSIs	ROI (savings in CAD)	Testimonials clinicians	Adverse reaction
Sault Area Hospital	ON	Jun-17	Hemodialysis	5	12	71	NA	\$2,925* in 3 months	Patients are doing very well, putting more patients on as we follow the new medical directive	None reported
St-Joseph Health Centre	ON	Sep-17	Hemodialysis	19	20	52	100	\$52,192 in 5 months	Patients will revert to the standard of care and data will be collected to compare effectiveness and ROI	metallic taste, "milky lines" in 9 out of 19 patients
St Johns Regional Health Centre	NB	Nov-17	Hemodialysis	30	12	41	NA	\$9,762* in 3 months	3-month trial with KiteLock reported a 47% reduction in alteplase use	none reported
Hôpital Maisonneuve-Rosemont	QC	Feb-18	Hemodialysis	11	12	ongoing	ongoing	ongoing	little alteplase has been used compared to before KiteLock; catheters seem to work more efficiently	none reported

*alteplase only

TABLE 2 - Summary of TPN beta evaluation October 2016-April 2018 - 18-month Canadian experience with 4% Tetrasodium EDTA lock solution								
Hosp	Prov	Start date	No of patients	Duration of evaluation (weeks)	Percent reduction in alteplase doses	Percent reduction in CLABSIs	Testimonials clinicians	Adverse reaction
St-Paul's Providence Health Centre	BC	16-Oct	24	72	100	50	Patients are able to aspirate better and the catheter feels similar to the first day it was inserted	transient metallic taste; transient tingling of lips
Fraser Valley Health Centre	BC	16-Oct	2	72	unknown	none reported	All is going well with Magnesium patient with an IVAD (new from November) who is on KiteLock 2x/week; delivery system and volume is a bit inconvenient	None reported
Ottawa General Hospital - TPN	ON	16-Oct	3	12	unknown	unknown	No comments at this time	Infection episode in patient rationing lock solution
Foothills Hospital	AB	17-Mar	1	56	1 used	1 experienced	Difficult to say given we only have one patient on, with one years experience. During that time she has had one bacteremia for enterococcus faecalis; It adds additional steps to their procedures which they are self managing. Design of ampule challenging. Has to use pliers to remove top. It has not been totally effective (i.e. one occlusion and one bacteremia while on therapy)	None reported
Toronto Children's Hospital*	ON	17-Sep	20	28	ongoing	100	going well, convincing evidence	Anemia due to aspiration of the lock
London TPN	ON	October 2017 (1); November 2017 (2); December 2017 (1)	4	16-24 weeks	100	100	so far, no infections, and no TPA required as of yet on these patients but only been 4-6 months, but some of these patients had frequent infections(every other month); Required some teaching, but minimal as these patients are independent in their line access/flushing, but now draw discard....also, had a lot of issues with community care access getting approval on each patient and coordinating with provider	None reported
Queen Elizabeth I Hospital	PEI				ongoing	ongoing	No comments at this time	None reported
McMaster Children's hospital*	ON	2018-01-01; March 2018	6	4-12 weeks	1 used	1 infection	Hope that infections would be reduced while on KiteLock; main disadvantage: Withdrawal of blood daily (hoping that the subsequent dose of KiteLock will clear any fibrin left from daily withdrawal of blood).	Line had become more stiff to flush and needed one dose of cath-flo after using KiteLock for several weeks (not sure if it is related to home nurse flushing and perhaps not doing as turbulent a flush or if related to KiteLock) – since cath-flo, no further issues.
St-Michael's Hospital	ON	17-Sep	3	24	100	100	patients have not been admitted for line infection since starting	a few patients thought they were having reactions, seemed nervous to use, difficult initially to get LIHN to pay for it, requires more teaching for administration than Hepalean as LIHN staff not familiar yet
University Health Network	ON	18-Mar	30	6	ongoing	ongoing	No comments at this time	None reported

*pediatric patients

DISCUSSION AND CONCLUSIONS

- ❖ Results highlight the ability of 4% T-EDTA to clinically reduce bacterial burden and biofilms in CVADs as well as providing well-established anticoagulant activities.
- ❖ Results also show a positive ROI for Canadian hospitals with the use of the approved catheter lock solution.
- ❖ Patients at high risk benefit from catheter maintenance and salvage with the use of 4% T-EDTA as the sole lock solution.
- ❖ Conversion of hospitals (low and high risk patients) is in progress to address benefits of both prevention and treatment.

REFERENCES

Pittiruti et al, 2016. Evidence-based criteria for the choice and the clinical use of the most appropriate lock solutions for central venous catheters (excluding dialysis catheters): a GAVECeLT consensus. J Vasc Access, 17(6):453-464.

Kanaa, M et al, 2015. Cathasept line lock and microbial colonization of tunneled hemodialysis catheters: A multicenter randomized controlled trial. Am J Kidney Dis, 66(6):1015-1023.

Percival SL et al, 2005. Tetrasodium EDTA as a novel central venous catheter locking solution against biofilm. Infection Control and Hospital Epidemiology,26(6):515-519.

Kite P et al, 2004. Use of in vivo-generated biofilms from hemodialysis catheters to test the efficacy of a novel antimicrobial catheter lock for biofilm eradication in vitro. Journal of Clinical Microbiology, 42(7):3073-3076.