



Are Buttonholes Making a Comeback?

**Maria Camila Bermudez, MD
Geisinger Medical Center, Danville PA
Annual Dialysis Conference.
Kansas City, MO
March 2023**

- **NO DISCLOSURES**

Buttonhole Cannulation Technique (BHC)

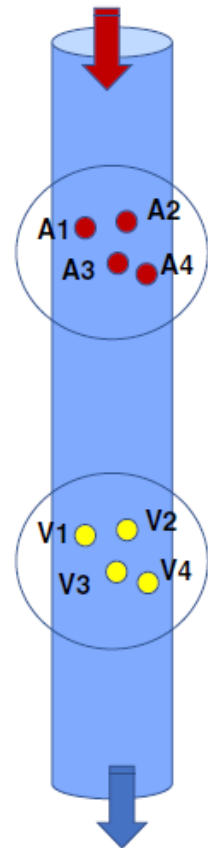
KIDNEY360 1: 306–313, April, 2020

Buttonhole Cannulation of AVF, Vachharajani et al. 307

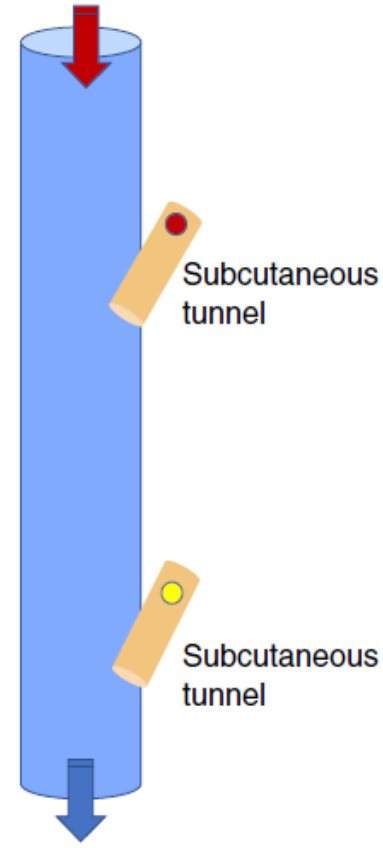
Rope ladder



Area cannulation



Button hole



Overview BHC



Past: 1970's
Dr. Twardoski



Present:
What have we
learned?



Our
experience



Future
perspectives

BHC: The Beginning

Buttonhole Principles and Risks



Dr. Twardowski's Original Study: Rope Ladder (RL) vs. Buttonhole (BH)
1979 in Poland

Categories	Rope Ladder	Constant Site	Study Results
Number of Fistulas	22	25	Needle insertion into BH is less painful
Number of Dialyses	4060	6180	# of Tx with BHs includes pts. with more frequent HD and two pairs of BHs
Time to insert needles (sec)	15 - 25	5 - 15	Needle insertion into BH is much quicker
Reinsertion (%) ("Bad sticks")	9.91	0.96	Needle misplacements are virtually eliminated with BHs
Hematoma formation (%)	12.5	0.1	Hematoma formation reduced > 100 times
Fistula limb failure	3	1	
Fistula failure	1	1	
Infection requiring ABX	1	3	Slightly higher with BH but not significantly
Patients' preference	No	Yes	Buttonhole preferred by patients
Nurses' preference	No	Yes	Buttonhole preferred by nurses

Twardowski Z, Kubara H. Dialysis & Transplantation 1979; 8(10):978-980

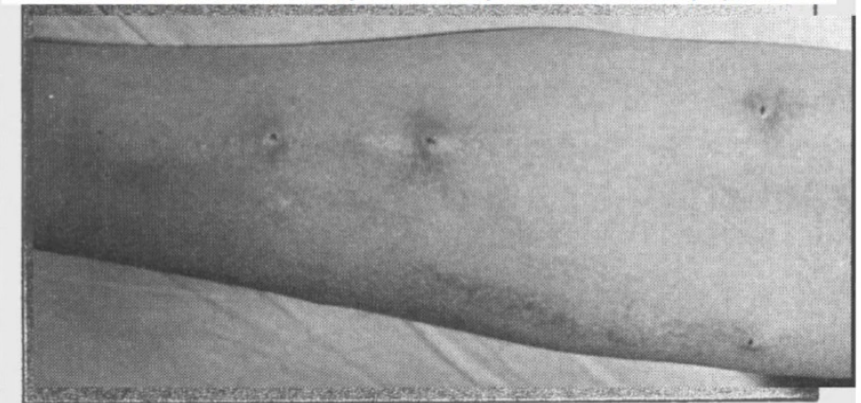
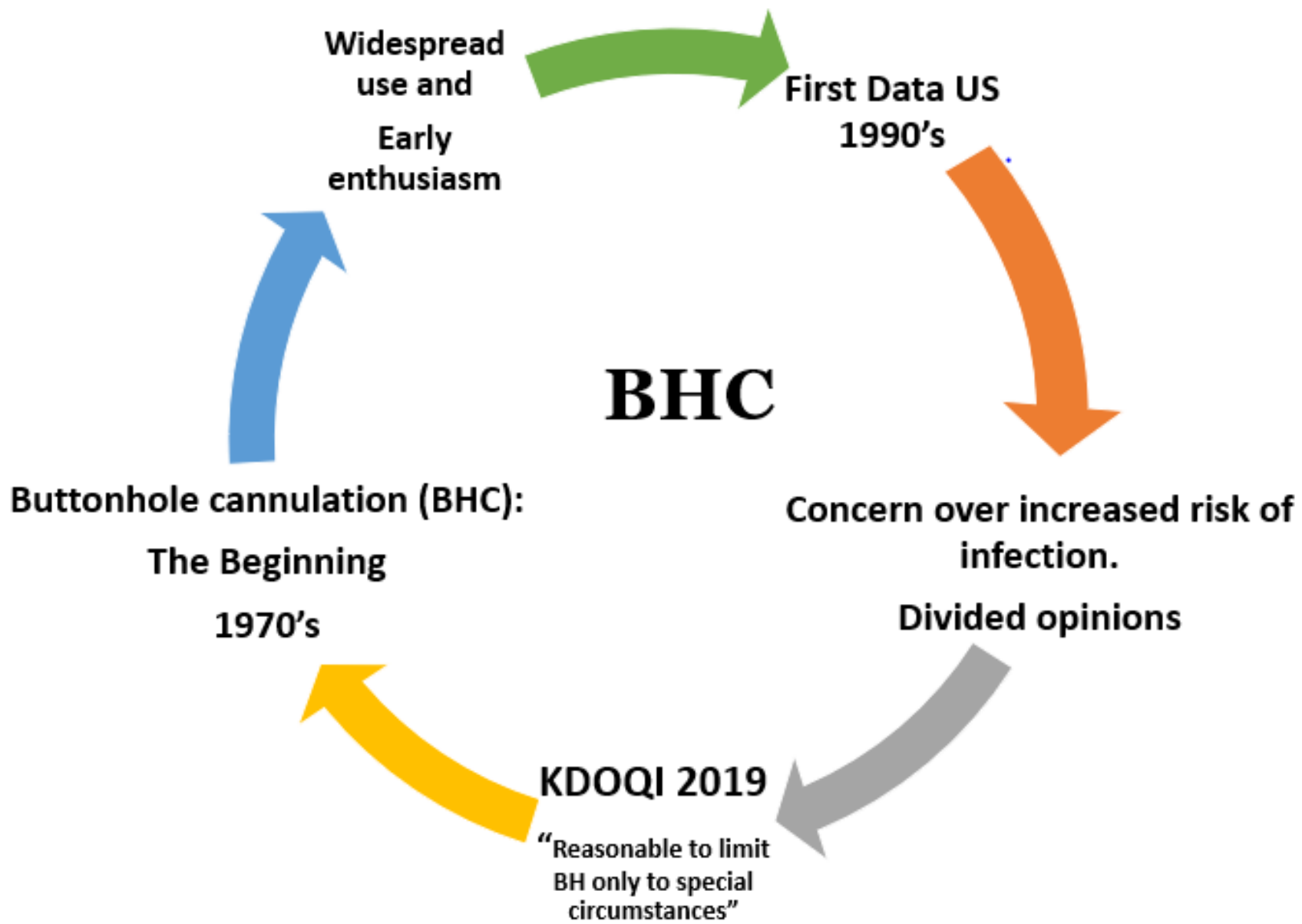
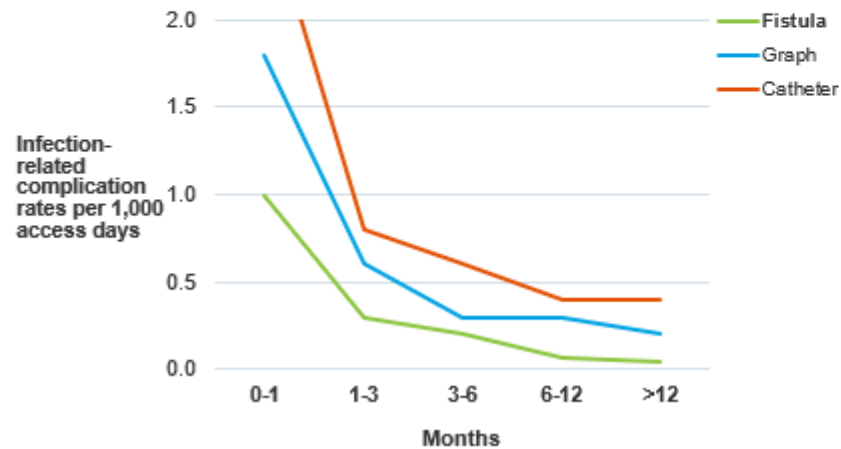


Figure 2: Six-year-old fistula with two pairs of puncture sites in a patient dialyzed four times weekly.

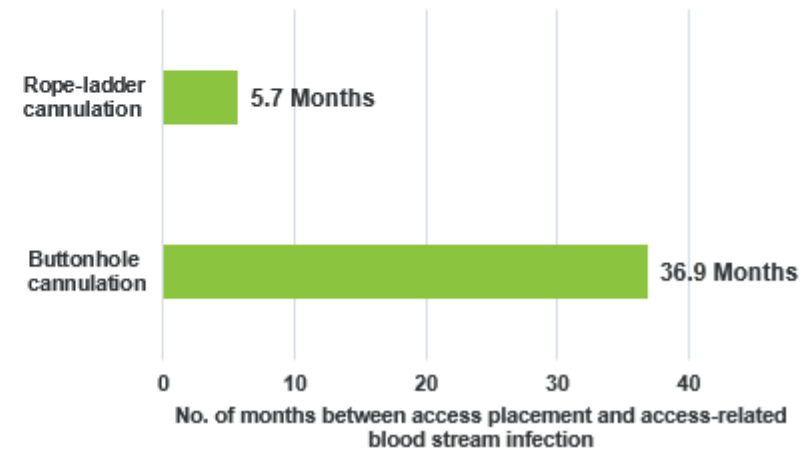


In- Center: Timing of infectious access complications varies by access type and cannulation technique

Time from access placement, or successful treatment of a previous complication, to first or subsequent complication in 7,140 in-center hemodialysis patients.¹



Time from AV fistula placement to access-related blood stream infection by cannulation technique among in-center hemodialysis patients reported by 6,010 facilities in 2014 by the National Healthcare Safety Network.²



1. Ravani, P., et al. *J Am Soc Nephrol.* 2013;(24):1668–1677. doi:10.1681/ASN.2012121234.
2. Lyman, M., et al. *Am J Kidney Dis.* 2020;(76):82–89. doi:10.1053/j.ajkd.2019.11.006.

PROPONENTS

- Short segment AVF.
 - Less pain, anxiety (?).
 - Less bleeding/infiltration
 - Frequent unsuccessful sticks.
 - Less interventions.
 - Less aneurysms.
- Ease of cannulation for self care /Home dialysis.



OPPONENTS

Increased risk of infection.



OUTCOME	INCREASED EFFECT	DECREASED EFFECT	NO DIFFERENCE
INFECTION	Christensen JH et al. Chsitensen LD et al. Glerup et al. Labriola et al. Collier et al. MacRae et al. Chow et al ? Van Eps et al Muir et al Chan et al Nesrallah et al. Chow et al Verhallen et al		Bernard Vo et al Struthers et al Vaux et al
		Marticorena et al Struthers et al ICHD Vaux et al ICHD	
PROCEDURES	Chan et al MacRae et al	Ludlow et al Van Loon et al Vaux et al	
POST- CANNULATION BLEEDING		Toma et al	MacRae et al Chow et al Vaux et al Struthers et al
HEMATOMA	Chow et al.	Struthers et al MacRae et al Kim et al Pergotoli et al	
PAIN		Toma et al Hallan et al van Jaarsveld et al AH Moss et al Ali Kal et al Verhalen et al	MacRae et al Vaux et al Struthers et al Chow et al

OUTCOME	INCREASED EFFECT	DECREASED EFFECT	NO DIFFERENCE
INFECTION	Christensen JH et al. Chistencen LD et al. Glerup et al. Labriola et al. Collier et al. MacRae et al. Chow et al Van Eps et al Muir et al Chan et al Nesrallah et al. Chow et al Verhallen et al		Bernard Vo et al (BH vs CVC) Struthers et al Vaux et al
ANEURYSM		Marticorena et al Struthers et al Vaux et al	
PROCEDURES	Chan et al MacRae et al	Ludlow et al Van Loon et al Vaux et al	
POST- CANNULATION BLEEDING		Toma et al	MacRae et al Chow et al Vaux et al Struthers et al
HEMATOMA	Chow et al.	Kim et al Pergotoli et al Struthers et al MacRae et al	
PAIN	van Loon et al.	Toma et al Hallan et al van Jaarsveld et al AH Moss et al Ali Kal et al Verhalen et al	MacRae et al Vaux et al Struthers et al Chow et al

Is it feasible to randomize patients training for home hemodialysis to buttonhole versus stepladder cannulation of the AVF?

Cohort



7 Canadian Hospitals
Nov 2013-Nov 2015



Home hemodialysis
training initiation
N=158



Eligible for
enrollment
N=50

Enrolled
N=14

Randomization



Cannulation
technique training



Total training
time (days)



VAS Pain score*
(median, IQR)



Buttonhole
N=8

19 ± 5

7.9
(0,30.3)



Stepladder
N=6

29 ± 14

8.9
(2.7,19.1)

*Higher score = more pain

Conclusions We were unable to demonstrate the feasibility of conducting a randomized controlled trial of buttonhole versus stepladder cannulation in Canada with a sufficient number of home hemodialysis patients to be able to draw meaningful conclusions.

Shih-Han Huang, Jennifer MacRae, Dana Ross, Rameez Imtiaz, Brittany Hollingsworth, Gilhad Nesrallah, Michael Copland, Philip McFarlane, Christopher Chan, and Deborah Zimmerman. Buttonhole Versus Step-Ladder Cannulation for Home Hemodialysis: A Multi-Center Randomized Pilot Trial. CJASN doi: 10.2215/CJN.08310718. **Visual Abstract by Michelle Rheault, MD**

A narrative systematic review of randomised controlled trials that compare cannulation techniques for haemodialysis

Table 1. List of clinical databases and clinical trial registries searched.

Clinical databases	Clinical trials registries
Cumulative Index of Nursing and Allied Health Literature (CINAHL)	UK Clinical Trials Gateway
Medline	Clinicaltrial.gov
PubMed	EU clinical trial register
EMBASE	ISRCTN registry
British Nursing Index (BNI)	WHO platform
Cochrane Register of Controlled Trials	Health Canada's Clinical Trials Database
Latin American and Caribbean Health Sciences Literature (LILACS)	Hong Kong Clinical Trials Register
	South African National Clinical Trial Register

Table 5. Assessment of criteria to progress to meta-analysis.

	Achieved	Not achieved
Same cannulation techniques?		X
Same cannulation protocol?		X
Define the outcome in the same manner?	X – pain only	
Measure the outcome using the same method?	X – pain only	
Measure the outcome over the same time period?		X
Is patient demographic data similar?		X

This was developed by the research team as part of the protocol development process, prior to implementing the systematic review.

All five RCTs:
infection as a secondary outcome.

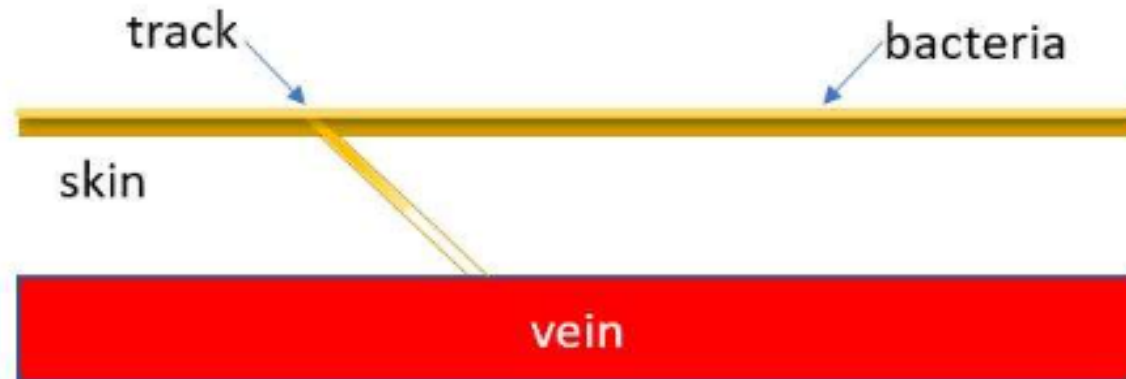
Only one RCT
significantly higher infection with BH, but only when bacteremia and site infections combined) (BH 12 vs RL 0, $p < 0.001$).

Three other RCTs
higher infection rate with BH, but there were no significant differences in the reported rates of infection between BH and comparator groups.

Why is Infection risk higher in BHC?

Illustration of a colonized track: The scab at the opening of the track can be assumed to have bacteria in it. The depth of entry of bacteria into the track is not known.

Image courtesy of Orly F. Kohn, MD.

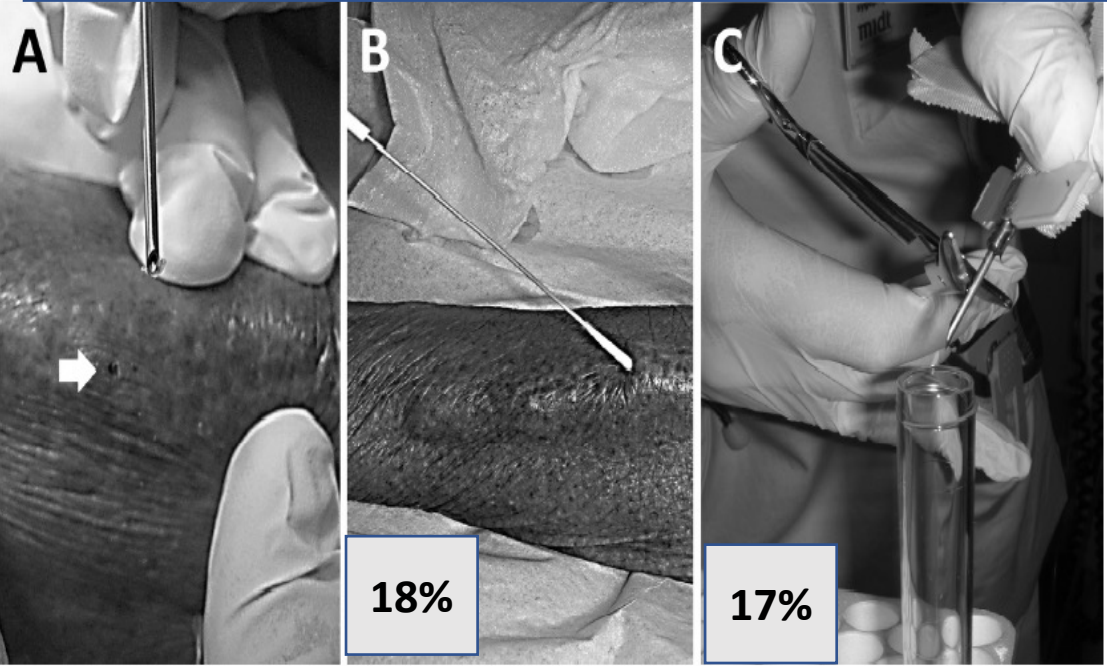


Bacteriology of the Buttonhole Cannulation Tract in Hemodialysis Patients: A Prospective Cohort Study



N=84

+ Growth on Q 1-month sets X3 months:



- Asymptomatic bacteremia: 30%
- ONE + blood culture from the track: (38%)



- Associated with more access infections (P < 0.001).

Figure 1. (A) The buttonhole (arrow) after removal of the tiny scab seen on the cannula tip. (B) The swab sample from the superficial buttonhole opening. (C) Cutting the cannula tip directly into the sterile tube.

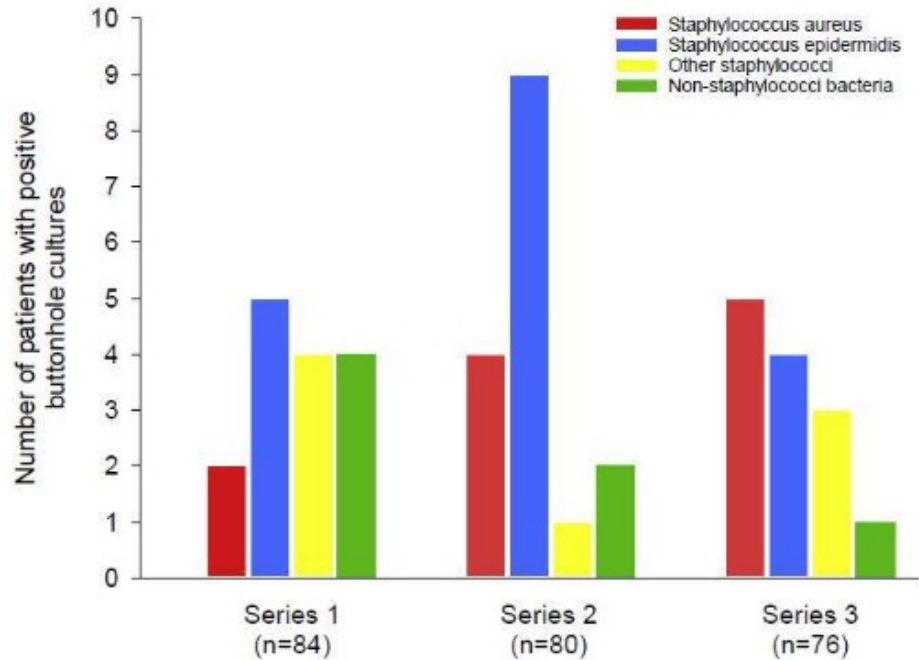


Figure 3. Number of patients having positive buttonhole cultures and the bacteria species in the 3 planned sampling series (n refers to number of patients investigated in each series).

Limitations:

No control group.

Blood cultures were obtained only from patients with positive buttonhole bacteriology.

No antibiotic cream.

Multiple cannulators.

Several factors can influence clinical outcomes

Infection

Aneurysm

Procedures

Bleeding

**Anxiety,
pain**

**Home Vs In-
center
HD**



Operator:
- Skills
- Single Vs
multiple



Technique:



**Policies and
procedures**



AVF



**Individual
characteristics**



A Randomized Trial Comparing Buttonhole with Rope Ladder Needling in Conventional Hemodialysis Patients

Jennifer M. MacRae,^{MD†} Sofia B. Ahmed,[†] Rajneet Atkar,[‡] and Brenda R. Hemmelgarn[†]

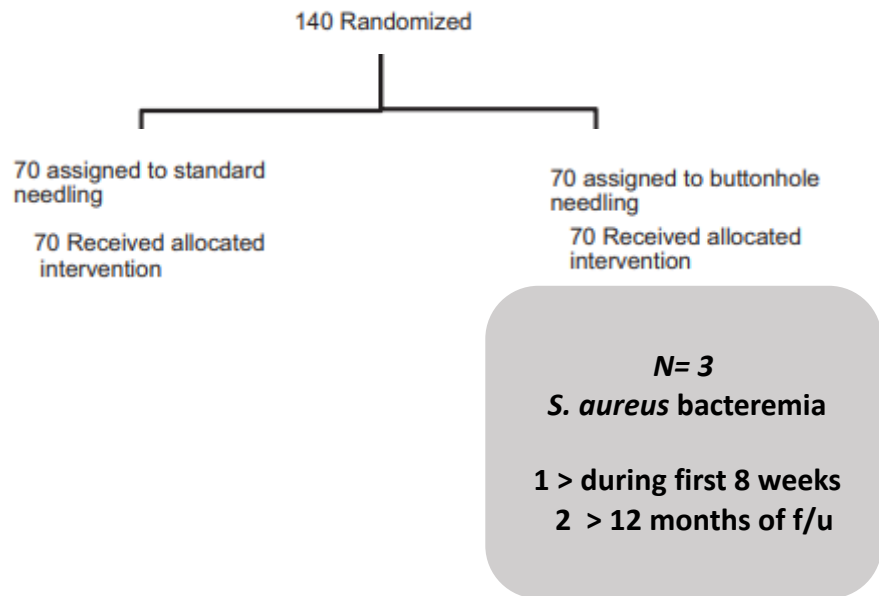


Table 3. Rates of secondary outcomes (per 1000 dialysis sessions) for standard and buttonhole needling

Outcomes	Standard Needling Rate per 1000 Dialysis Sessions	Buttonhole Needling Rate per 1000 Dialysis Sessions	P Value
Hematoma formation	436	295	0.003
Bleeding postdialysis			
No bleeding	23.6	28.3	
Any bleeding	97.6	97.2	0.40
Signs of localized infection	22.4	50.0	0.003

Signs of localized infection included erythema, pus, or swelling at the fistula site.

LIMITATIONS:

- Patients who self needled were excluded.
- Same nurse during track creation (2-3 wks) and up to 1 week into blunts, then multiple nurses.
- Topical exit site Antibiotic (AB) prophylaxis was not used.

Cannulating in haemodialysis: rope-ladder or buttonhole technique?

SELF-CANNULATING, HOME HEMODIALYSIS PATIENTS

Methods:
Prospective, observational study
18 months

Table 1. Within-patient comparison of the rope-ladder technique used at baseline and the buttonhole technique used during 18 months of follow-up

	Baseline (n = 32)	1.5 mo (n = 18)	3 mo (n = 14)	6 mo (n = 18)	12 mo (n = 11)	18 mo (n = 3)	Mean (1.5–18 mo)	P-value (baseline vs mean)
Cannulating ease ^a	2.9 ± 2.4	1.7 ± 1.9	1.5 ± 1.4	1.3 ± 1.0	1.0 ± 1.3	1.6 ± 1.5	1.3 ± 1.2	0.002
Cannulating pain ^a	2.3 ± 2.2	1.6 ± 2.0	1.5 ± 1.8	2.2 ± 2.0	1.0 ± 1.1	1.0 ± 1.7	1.6 ± 2.0	0.12
Bad sticks ^b	0.8 ± 1.4	0.4 ± 0.8	0.4 ± 0.6	0.4 ± 0.9	0.2 ± 0.6	0.0 ± 0.0	0.3 ± 0.6	0.03
Compression time (min)	8.7 ± 3.6	8.4 ± 3.8	7.9 ± 3.5	7.4 ± 3.8	7.7 ± 3.6		7.6 ± 4.0	0.004

Table 2. Nurse's assessment on the buttonhole technique in the 33 patients

	Improvement	No change	Worsening
Cannulating ease	31	1	1
Cosmetic results	12	21	0
Overall results	26	6	1

- **3 patients developed LOCAL skin infections (PO AB)**
- **NO BACTEREMIA or ANEURYSMS.**
- **Patients with short fistulas did better as patients that had extreme cannulation fear. .**

Buttonhole Cannulation Is Not Associated with More AVF Infections in a Low-Care Satellite Dialysis Unit: A Long-Term Longitudinal Study

Table 2. AVF-related infections per period.

Infectious event	Period 1	Period 2	p value ^δ
Local infection (alone)			
Number	2	7	
AVF-days	57851	97911	
incidence rate (per 1000 AVF-days)	0.03	0.07	0.7
95%CI	(0.028–0.031)	(0.068–0.071)	
Bacteremia (alone)			
Number	0	2	
AVF-days	57851	97911	
incidence rate (per 1000 AVF-days)	0	0.02	0.5
95%CI	-	(0.019–0.020)	
Combined local infection and bacteremia			
Number	1	4	
AVF-days	57851	97911	
incidence rate (per 1000 AVF-days)	0.02	0.04	0.6
95%CI	(0.002–0.015)	(0.015–0.109)	
All infections			
Number	3	13	
AVF-days	57851	97911	
incidence rate (per 1000 AVF-days)	0.05	0.13	0.44
95%CI	(0.02–0.16)	(0.08–0.23)	

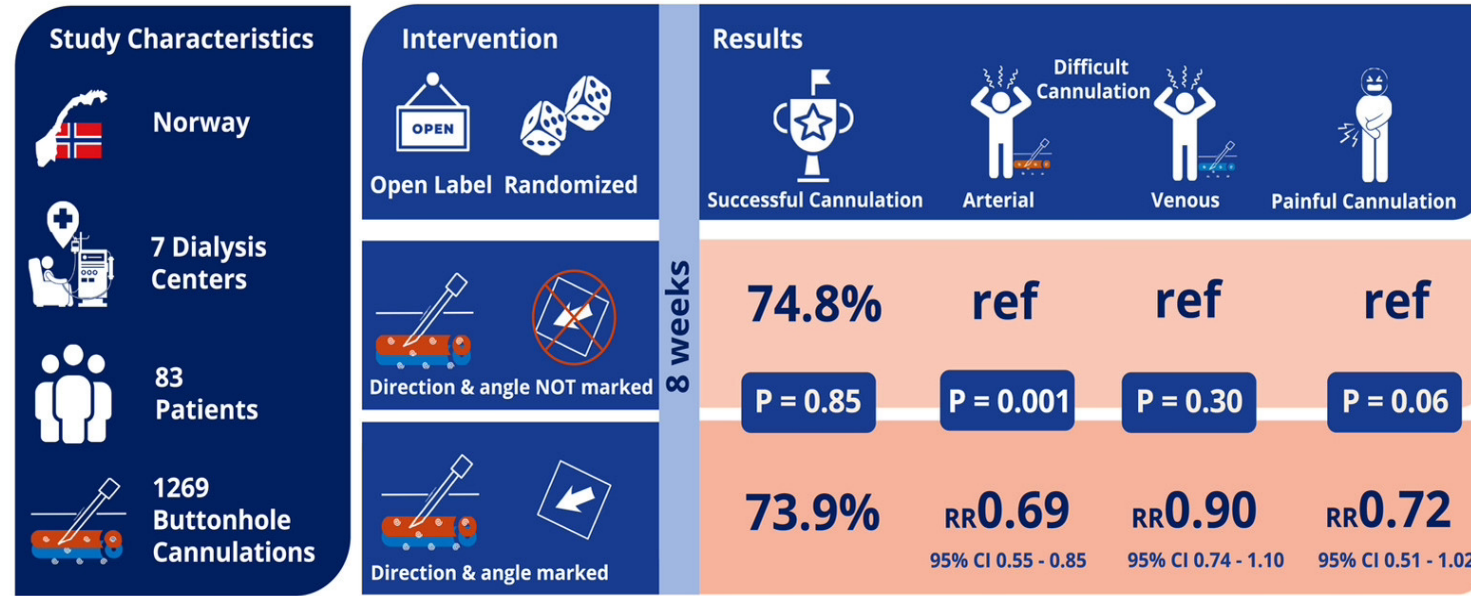
^δ Fisher exact test

NOTE

Limitation: Retrospective, single center.

- Satellite units are low-care units as compared to in-center ones.
- Younger pts, less comorbidities.
- Nursing team and number of patients are smaller with better knowledge of each AVF.
- Low team turnover.

Is direction and angle-assisted buttonhole cannulation of AV-fistula in hemodialysis patients beneficial?



Conclusion: Marking direction and angle of cannulation did not improve buttonhole cannulation success rates, but patients more often reported an unproblematic procedure and less pain.

Reference: Ronning MI, Benschop P, Øvrehus MA et al. Direction and angle-assisted buttonhole cannulation of AV-fistula in hemodialysis patients – a multicenter randomized controlled trial. *Kidney Medicine*, 2022.
Visual Abstract by Sai Sudha Mannemuddhu, MD, FAAP @drM_Sudha

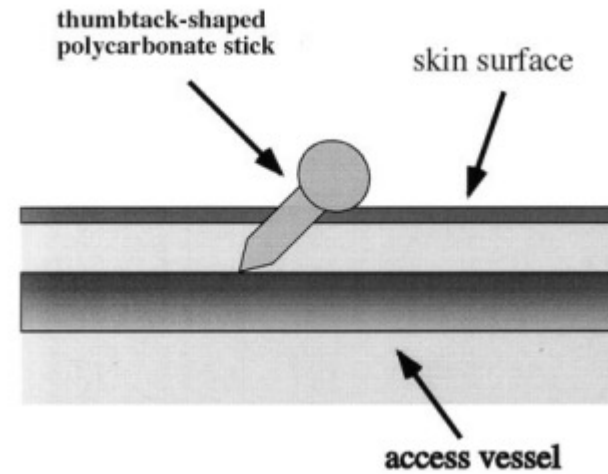
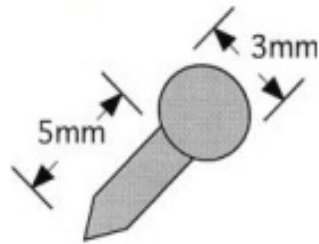


LIMITATIONS:

- Small sample size.
- No extra training of the nurses.
- Multiple cannulators: RNs rotated randomly between the intervention and control patients.

A timesaving method to create a fixed puncture route for the buttonhole technique

Fixed puncture route for the buttonhole technique



37 patients, 3 months

No more pain or bleeding.
Only one patient had possible site infection.

LIMITATIONS:

Uncertain long-term results

Effect of Buttonhole Cannulation With a Polycarbonate Peg on In-Center Hemodialysis Fistula Outcomes: A Randomized Controlled Trial

	Usual Practice (n = 69)	Buttonhole (n = 58)
Patient status		
Completed study	52 (75)	48 (83)
Died	5 (7)	8 (14)
Transplantation	3 (4)	2 (3)
No. of AVF failures	9 (13) ^a	0 (0)
Days to AVF failure		
Median [IQR]	268 [143-292]	NA
Minimum; maximum	7; 328	NA

Table 4. Enlargement of Any Existing Aneurysm and New Aneurysm Formation

	Buttonhole	Usual Practice
Total no. with existing aneurysm	13	15
Change in aneurysm size		
Bigger	3 (23)	10 (67)
Same size	6 (46)	4 (27)
Smaller	1 (8)	1 (7)
Unknown	3 (23)	0 (0)
Total no. with no existing aneurysm	45	54
Development of new aneurysm		
Yes	2 (4)	9 (17)
No	38 (84)	36 (67)
Unknown	5 (11)	9 (17)

	Fistuloplasty for Stenosis	Successful Thrombectomy	Total No. of Interventions
Usual practice, n = 69	25 (36)	2 (3)	27 (39)
Buttonhole, n = 58	10 (17)	1 (2)	11 (19)

- **No bacteremia.**
- **2 exit-site infections in BH.**
- **61% nurses preferred BH.**

LIMITATIONS:

- Lack of blinding.**
- “Survivor bias”.**
- Single center .**

STRENGTH:

Track was established by the same nurse.

A RANDOMISED CONTROLLED TRIAL OF BUTTONHOLE CANNULATION FOR THE PREVENTION OF FISTULA ACCESS COMPLICATIONS

Josephine Chow^{1,2}, MBA, PhD, MNsg, BAppSci, Glenda Rayment³, MSc Nsg, Graduate Cert. Renal Nursing, Susana San Miguel³, Graduate Cert. Ed., Graduate Cert. Renal Nursing, Margaret Gilbert³, Graduate Cert. Renal Nursing

Event	Buttonhole (N = 34)		Usual care (N = 35)	
Death	2		1	
Chest or abdominal pain	4		2	
Fistula complication	4		2	
Haematoma*	4		0	
Site infection	ICHD	4	HHD	1
Site pain during dialysis**	5		0	

- Multicenter, prospective, open label.
- Six-month f/u.
- AVF and saphenous AVG.
- HHD and ICHD: same initial cannulator for 2 weeks then multiple cannulators
- Of the 4 BH site infections just one had bacteremia and 3 reported lapses in skin prep (p=0.11)
- Staff in learning phase, raise concerned about appropriateness of scab removal

Infectious Complications Following Conversion to Buttonhole Cannulation of Native Arteriovenous Fistulas: A Quality Improvement Report

Study Design: Quality improvement. **Observational, partly retrospective.** Intensive edu workshops decreased infections in BH.

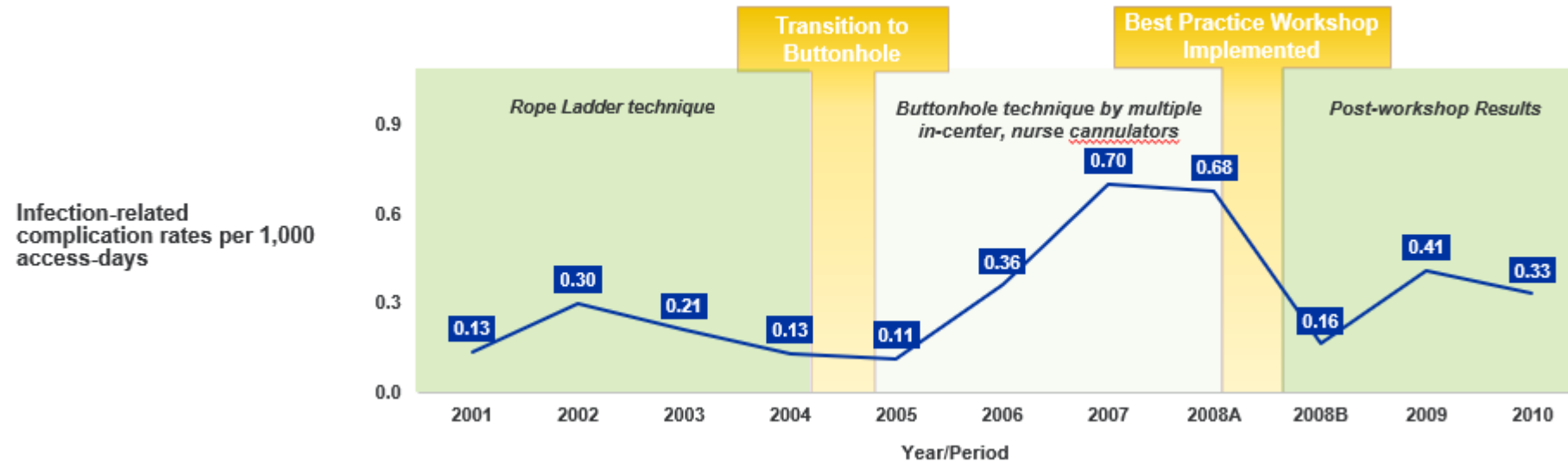


Table 2. Incidence of Infectious Events Per Period

Infectious Events	Period 1 (rope-ladder technique)	Period 2 (progressive shift to BH)	Period 3 (BH before workshops)	Period 4 (BH after workshops)
Total no. of infectious events	11	1	31	14
Absolute incidence of all infectious events ^a	0.17 (0.086-0.31)	0.11 (0.0014-0.63)	0.43 (0.29-0.61)	0.34 (0.19-0.55)
Complicated infectious events (n)	0	0	11	1
Absolute incidence of complicated infectious events ^a	0	0	0.153 (0.076-0.273)	0.024 (0.001-0.118)

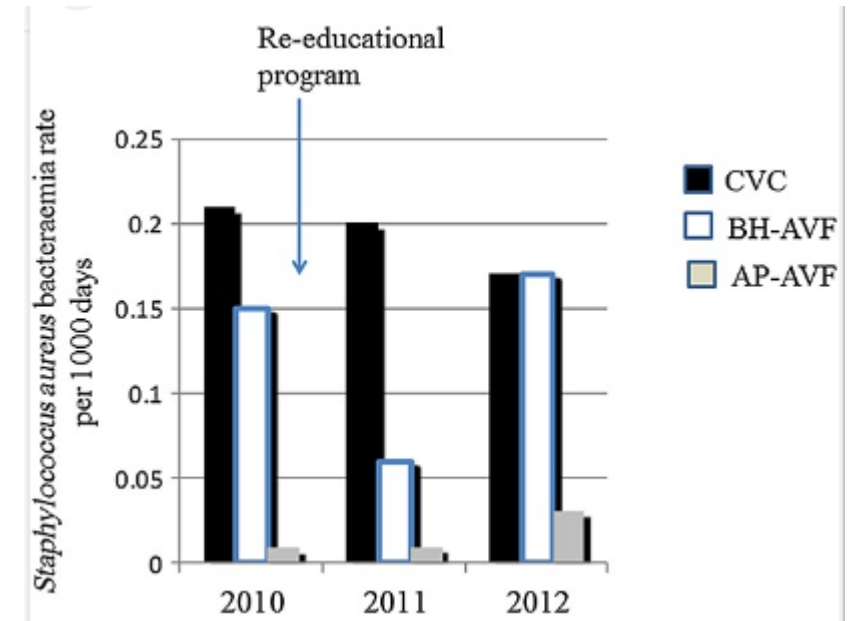
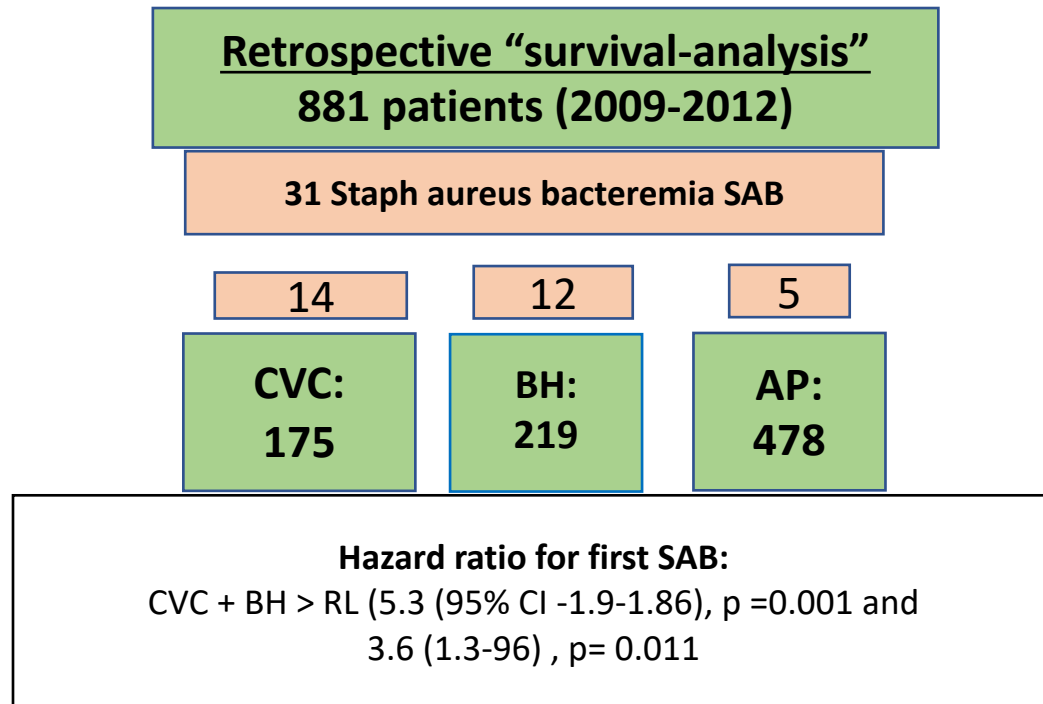
Note: When provided, confidence intervals are in parentheses.

Abbreviations: AVF, arteriovenous fistula; BH, buttonhole.

^aPer 1,000 AVF-days.

Infection Rates Following Buttonhole Cannulation in Hemodialysis Patients

Sophie Collier,¹ Hala Kandil,¹ Enat Yewnetu,¹ Jennifer Cross,² Ben Caplin,² and Andrew Davenport²



- Q 3-month nasal MSSA/MRSA screening .
- Decolonization protocol: 5 d of mupirocin or hibitane preceded by chlorhexidine washing.
- 85% of patients with SAB had + nasal screen.

Staphylococcus aureus Bacteremia and BHC: Long-Term Safety and Efficacy of Mupirocin Prophylaxis

Follow-up times and SAB episodes before and after the introduction of the mupirocin cream prophylaxis start date (January 1, 2004)

	By Treatment Period ^a	As-Treated ^b
Preintervention		
follow-up time for entire cohort (years)	93.4	98.1
mean ± SD follow-up time in years per subject (range)	2.7 ± 1.7 (0.2 to 5.7)	2.7 ± 1.7 (0.2 to 5.7)
infection episodes	8	10
infection rate (events/1000 AVF-days)	0.23	0.28
Postintervention		
follow-up time for entire cohort (years)	193.5	188.6
mean ± SD follow-up time in years per subject (range)	4.3 ± 1.9 (0.4 to 5.4)	4.3 ± 1.9 (0.4 to 5.4)
infection episodes	2	0
infection rate (events/1000 AVF-days)	0.03	0
OR (95% CI) ^c	6.4 (1.3, 32.3)	35.3 (2.0, 626.7)
CHD controls		
follow-up time for entire cohort (years)	-	565.9
infection episodes	-	1
infection rate (events/1000 AVF-days)	-	0.005

^aFollow-up time on treatment calculated from January 1, 2004; infections attributed to study period.

^bFollow-up time on treatment calculated from actual intervention start date for subjects initially not adherent to study intervention (*n* = 2); SAB episodes attributed to intervention status—"as-treated" analysis.

^cOR as calculated by univariate logistic regression.

Study:

Retrospective pre-post comparison of SAB rates after establishing Mupirocin to track.

Findings:

Post intervention episodes of SAB were documented only in patients who were non-adherent to the prescribed regimen.

Buttonhole Needling of Ateriovenous Fistulae: A Randomized Controlled Trial

- 56 pts (28 RL Vs 28 BH)
- No more than 2 nurses
- One localized infection in the BH group
- Not powered to demonstrate increased risk of infection

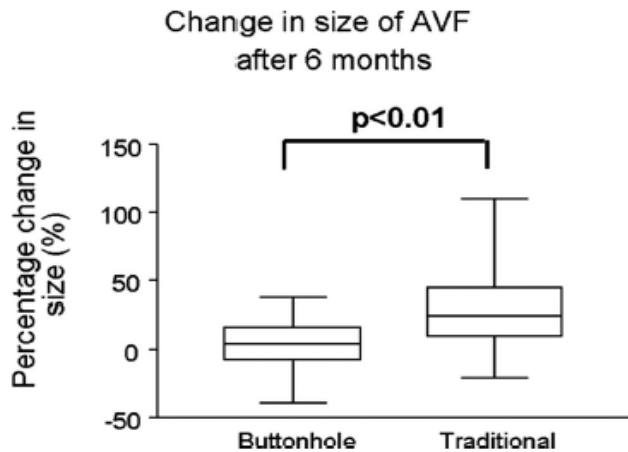


Figure 2. Percentage change in size of fistulae measured at maximum diameter before and after 6 months comparing buttonhole and traditional methods.

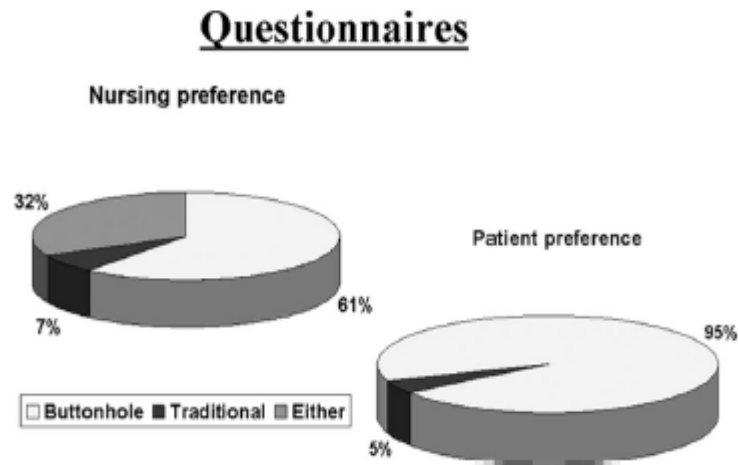


Figure 3. Questionnaire results for nursing staff and patients comparing buttonhole with traditional methods of needling.

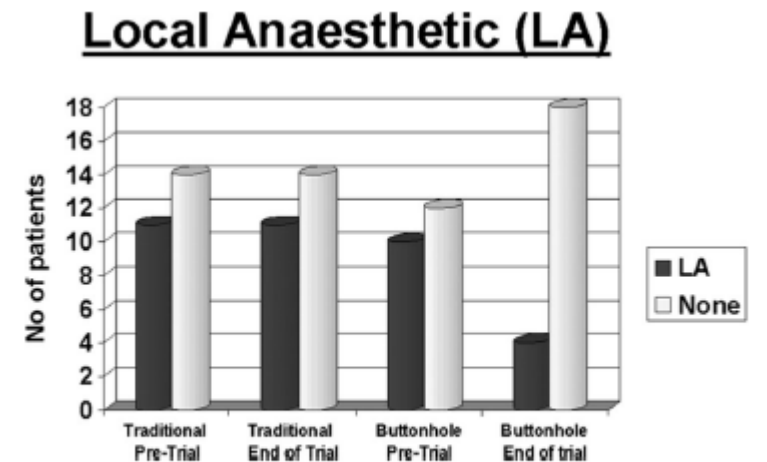


Figure 1. Use of local anaesthetic (LA) in patients using traditional and buttonhole techniques before and after the trial.

Dialysis efficacy and pain levels in relation to cannulation distance using the buttonhole technique

Two groups: distance between the arterial and venous needle points.

Group 1: 5–7 cm in 25 patients.

Group 2: 7–10 cm in 19 patients.

Table 1 Descriptive statistics. Kt/V and needle distance

	Needles distance	Mean	Std. deviation	N
Kt/V urea first	5-7 cm	1.4496	0.36151	25
	7-10 cm	1.5384	0.29203	19
	Total	1.4880	0.33260	44
Kt/V urea second	5-7 cm	1.4808	0.23750	25
	7-10 cm	1.5137	0.20307	19
	Total	1.4950	0.22140	44

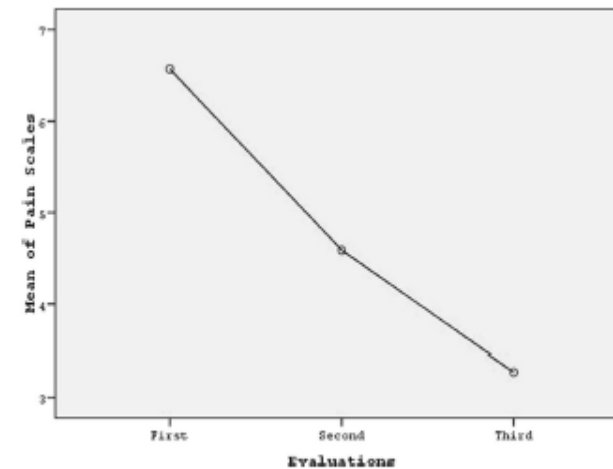


Fig. 1 Time course of pain scale: first (0), second (6) and third (12th month) pain levels (change in pain level when switching from robe ladder technique to buttonhole technique)

BHC technique may be preferred because it is less painful, does not differ from the RL method in efficacy and can be applied to shorter vasculature.

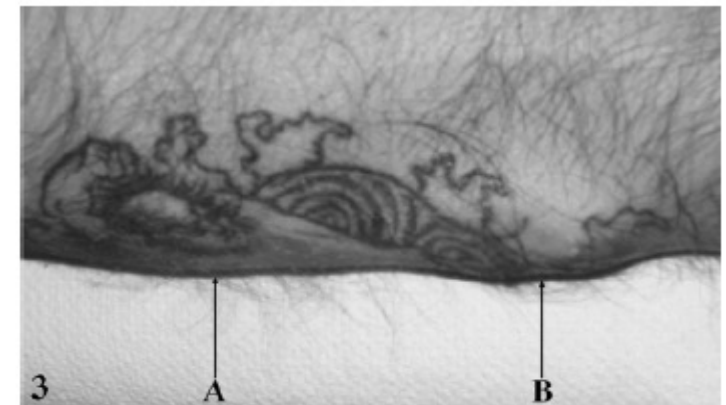
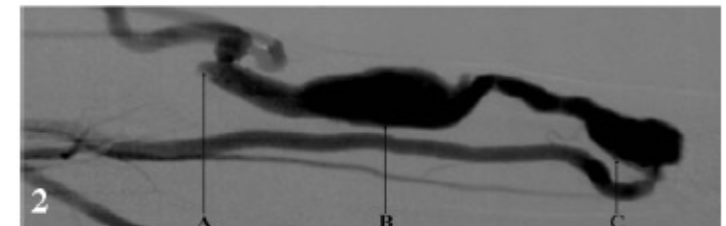
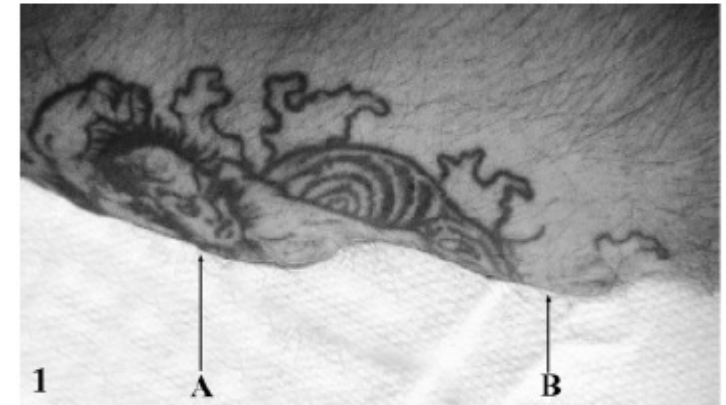
The salvage of aneurysmal fistulae utilizing a modified buttonhole cannulation technique and multiple cannulators

DESIGN:

- Prospective cohort study, no control group.
- 14/200 in-center chronic HD patients.
- 1 year follow.

RESULTS:

- All had improvement of bleeding and pain.
- 9 have progressed to self-cannulation.
- 4 transitioned to HHD.
- 2 bacteremias -> implementation of AB cream to the track with no more infections.
- 2 cases: remodeling of the fistula and shrinkage of the aneurysm.



OUTCOME	INCREASED EFFECT	DECREASED EFFECT	NO DIFFERENCE
INFECTION	Christensen JH et al. Chistencen LD et al. Glerup et al. Labriola et al. Collier et al. MacRae et al. Chow et al Van Eps et al Muir et al Chan et al		Bernard Vo et al (BH vs CVC) Struthers et al Vaux et al
PROCEDURES	Chan et al MacRae et al	Ludlow et al Van Loon et al Vaux et al	
POST- CANNULATION BLEEDING		Toma et al	MacRae et al Chow et al Vaux et al Struthers et al
HEMATOMA	Chow et al.	Kim et al Pergotoli et al Struthers et al MacRae et al	
PAIN	van Loon et al.	Toma et al Hallan et al van Jaarsveld et al AH Moss et al Ali Kal et al Verhalen et al	MacRae et al Vaux et al Struthers et al Chow et al

Criteria for Determining Type of Self-Cannulation

Indications for Rope Ladder Cannulation	Check Items That Apply
AVF is relatively straight	
AVF is newly created and dynamic (developing and changing)	
Patient experiences hand tremors Poor technique may lead to the creation of multiple tracts if buttonhole (BH) cannulation is used	
Patient reports or demonstrates difficulty with vision Poor vision and improper placement of needle on the BH may lead to the creation of multiple tracts if BH cannulation is used	
Patient expresses fear related to self-cannulation, but is nonetheless prepared to attempt self-cannulation	

Total Number of Check Marks:

Indications for Buttonhole Cannulation	Check Items That Apply
AVF is short in length or short usable segments	
AVF has torturous anatomy	
AVF developed aneurysmal dilation	
AVF is mature and no longer dynamic	
AVF is difficult to cannulate The patient is unable to self-cannulate use the RL technique	
Patient displays needle phobia Patient expresses considerable fear related to self-cannulation	

Total Number of Check Marks:



Our Process

Patient Identification.

Infection Prevention Strategies.

Buttonhole Preservation Strategies.

Aseptic Technique and Follow up

ABSOLUTE need for great pre-treatment access care

Scab removal

Mupirocin AB cream to track

Monthly clinic re-education

Access “diary”

BUTTONHOLE TRACK PRESERVATION STRATEGIES



ONE AND ONLY ONE CANNULATOR



INPATIENT POLICY



VACATION POLICY



FISTULOGRAM POLICY



INPATIENT POLICY

Purpose:

To be able to maintain the buttonhole tracks by allowing patient or caregiver to access BH while inpatient and during vascular procedures.

Procedure

1. Patient will bring blunt needles from home (admission Kit).
2. Cannulation will be done according to the training of the cannulator (including pre- cannulation and post- cannulation care).
3. If cannulator unable to do it, IP dialysis nurse will access AVF using RL technique away from BH track.
4. Mupirocin cream to be applied to track post- cannulation as per unit protocol.
(EPIC ORDER SET).

HHD Program 2008-2023 (Selinsgrove PA, Davita)

Tables 1 to 4 show characteristics of all the patients who have been in Home Hemodialysis program.

Table 1: Current status of all patients (n=76) in the HHD program:

	Current status (n=76)
Currently in the HHD program	18 (23.7%)
Deceased	23 (30.3%)
Transitioned to In-Center HD	19 (25.0%)
Transplanted	13 (17.1%)
Status unknown	3 (3.9%)

Table 2: Duration of being in the HHD program for all (n=76) patients

Duration of Home Hemodialysis	n	%
Less than 6 months	24	31.6
6 months to 1 year	18	23.7
1 to 2 years	14	18.4
2 to 5 years	13	17.1
More than 5 years	7	9.2

Table 4: Access history of all patients (n=74) in the HHD program

Duration of Home Hemodialysis	Access					
	AVF	AV Graft	AVF to CVC	CVC	CVC to AVF	CVC to AVG
Less than 6 months	17	3	-	3	-	-
6 months to 1 year	14	-	1	3	-	-
1 to 2 years	12	-	1	-	1	-
2 to 5 years	11	-	1	-	-	-
More than 5 years	6	-	-	-	-	1




No documented bacteremia in our HHD population dialyzing via AVF (BH) since start of the program.

Anecdotal: few local skin infections (not tracked).

Characteristic		N (%)	
Modality of Home hemodialysis	With care partner	13 (92.9)	✓
	Solo	1 (7.1)	
Who is the care partner	Spouse / Partner	10 (76.9)	✓
	Parent	2 (15.4)	
	Child	1 (7.7)	
	Sibling	-	
	Friend	-	
Current dialysis access	Arteriovenous fistula	14 (100)	
A fistula was present before starting dialysis		9 (64.3)	
Total fistulas since starting dialysis	None	-	
	One	9 (64.3)	✓
	Two	3 (21.4)	
	More than two	2 (14.3)	
Number of fistulograms in the past year	0	3 (21.4)	
	1	6 (42.9)	✓
	2 or more	5 (35.7)	
If had fistulogram in the past year, was it scheduled	Scheduled	10 (83.3)	✓
	Emergent	2 (16.7)	
Technique to access fistula	Buttonhole	13 (92.9)	✓
	Rope ladder	1 (7.1)	
Primary person to access fistula	Partner	8 (57.1)	✓
	Self	6 (42.9)	

13 out of 14 pts perform BHC

- **Majority of care partners are spouses.**
- **42 % Self-cannulate (50 % do so with non dominant hand).**
- **Majority of pts (64%) had only one fistulogram within last year.**
- **>80% of fistulograms were elective and ER was avoided 100% times.**

Before starting dialysis concern about needle pain	Not at all or slightly	10 (71.4) 
	Very or Extremely	4 (28.6)
During training, concern about needle pain	Not at all or slightly	10 (71.4) 
	Very or Extremely	4 (28.6)
Factors that help in reducing needle related distress	Nursing support	2 (16.7)
	Education about cannulation	1 (8.3)
	Increasing confidence my or partner's ability to cannulate	9 (64.3) 

Slight or no concern about needle pain at dialysis start and during training (71.4%)



Increasing confidence on their own or partner's ability to cannulate reduced distress related to cannulation.

Current concern about needle pain	Not at all or slightly	12 (85.7)	✓
	Moderately, Very or Extremely	2 (16.7)	
Think buttonhole technique help in reducing needle related distress		9 (69.2)	✓
Frequency of pain while accessing fistula	Never or rarely	10 (71.4)	✓
	Sometimes, very often or always	4 (28.6)	
Frequency of infiltration while accessing fistula	Never or rarely	14 (100)	✓
	Sometimes, very often or always	-	
Frequency of prolonged bleeding while accessing fistula	Never or rarely	13 (92.8)	✓
	Sometimes, very often or always	1 (7.1)	
Frequency of aneurysm formation while accessing fistula	Never or rarely	13 (92.8)	✓
	Sometimes or very often	1 (7.1)	
Frequency of inability to complete dialysis because of difficulty with cannulation	Never or rarely	14 (100.0)	

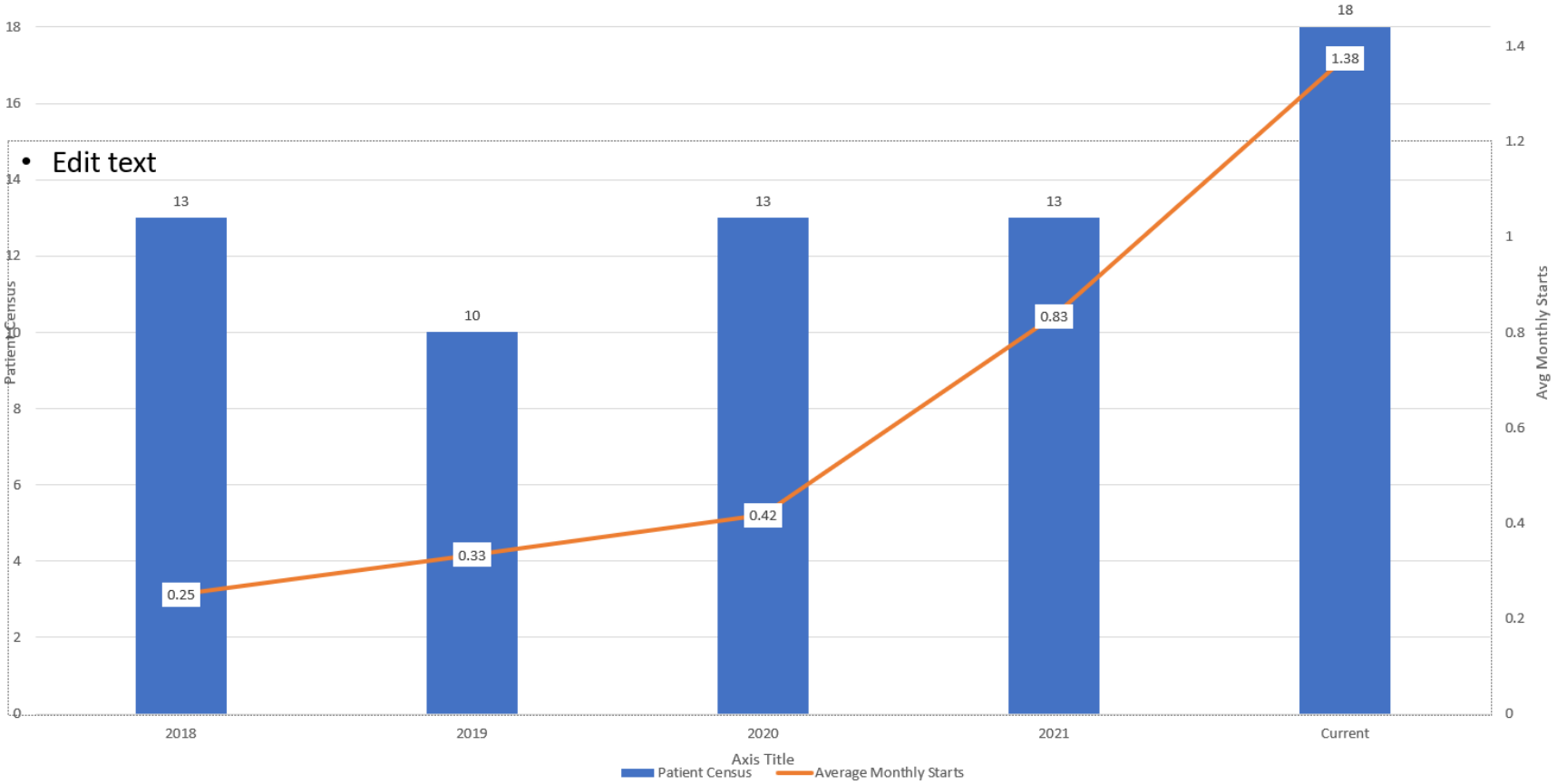
86% had current little to no concern about needle related pain and majority thought Buttonhole helps reducing needle related distress.

Infiltration, bleeding, aneurysm were uncommon.

All patients said having difficulty with cannulation leading to inability to dialyze: Never or Rare

Frequency of fistula infection since starting buttonhole technique	Never	14 (100.0) 
	Once	-
	Twice or more	-
Felt supported by the team when having issues with fistula	Almost always or often	14 (100.0) 
	Sometimes, seldom or never	-

HHD PROGRAM GROWTH SINCE SELF-CANNULATION PROGRAM INITIATION

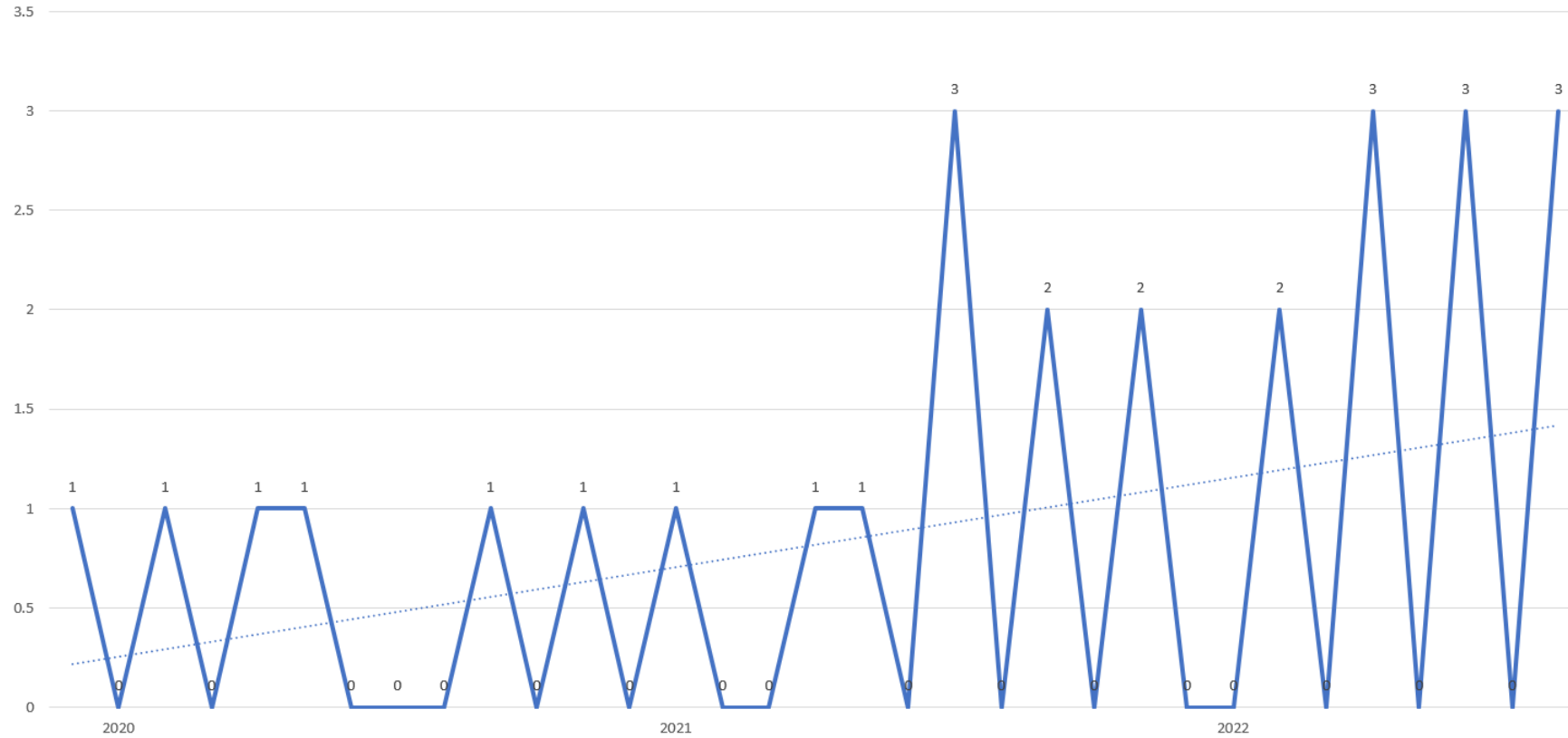


• Edit text

Axis Title
Patient Census Average Monthly Starts

- Edit text

HHD Starts by Month



	<u>2018</u>	<u>2019</u>	<u>2020</u>	<u>2021</u>	<u>Current</u>
Average Monthly Starts	0.25	0.33	0.42	0.83	1.38

KEY ELEMENTS BUTTONHOLE CANNULATION

Table 1. Nephrologists Transforming Dialysis Safety focus group responses from nephrologists and advanced practice providers

Category	Response from Focus Group Participant
Patient selection	<p>“It needs to be the right patient at the right time.”</p> <p>“Home patients are more attentive.”</p> <p>“Currently patients who dialyze at home are in the top tier of self-motivation and are currently self-selected. As we increase home dialysis, it will be essential to adapt current practices to allow for more patients who [may not fit these criteria].”</p>
Modality specific	<p>“Fewer patients would be able to choose home if they can’t use buttonholes.”</p> <p>“Buttonholes should not be created for in-center patients, there is a lot of infection historically, but it’s okay for home patients.”</p>
Technique and training	<p>“There should be a checklist for buttonhole cannulation.”</p> <p>“Multiple cannulators increase the risk of infection, for example, when there is an in-center creation by clinic staff before the patient is sent home.”</p>
Best practices guidance	<p>“Strict aseptic technique needs to be followed (do not use ‘scab removers’).”</p> <p>“NTDS should create a buttonhole registry.”</p> <p>“If NTDS would come up with a position or recommendations on using buttonholes, [we] would go with that.”</p>

NTDS, Nephrologists Transforming Dialysis Safety.

Limited Experience Heralds Widened Clinical Interpretation And a Frontier of Opportunity



SINGLE CENTER, OBSERVATIONAL STUDIES:

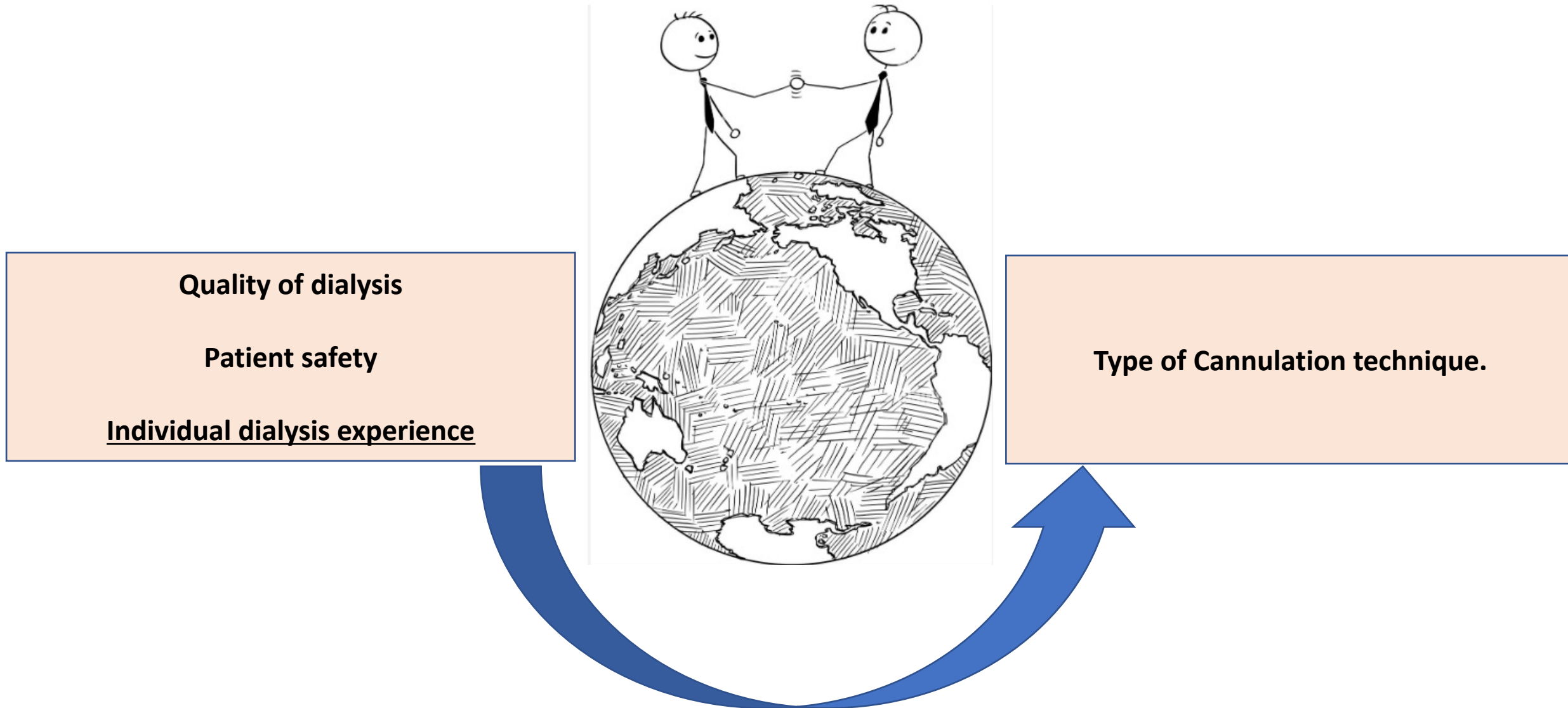
- OFTEN OVERLOOKED.
- MAY YIELD CONSTRUCTIVE CONTRIBUTIONS TO BEST DEMONSTRATED PRACTICES.



FUTURE NEEDS AND POTENTIAL FOR RESEARCH:

- HOMOGENEOUS, TARGETED GROUPS:
HHD, self-care, single operators.
- STANDARDIZED PROTOCOL .

RIGHT ACCESS, RIGHT CANNULATION METHOD, RIGHT PATIENT



**Reframing Buttonhole
Cannulation and its
role in self-care and Home
Hemodialysis.**
