PRACTICAL STRATEGIES IN MANAGING THE HOME HEMODIALYSIS PATIENT

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Outline

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- Challenges and Solutions: The big picture
- Setting goals
- Implementing a treatment plan
  - Prescription
- Vascular access
- Preventing and managing infections
- Balancing benefits and burdens

Challenges: Differences between in center (ICHD) versus home hemodialysis (HHD)

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Infrastructure and Staff		
	ICHD 2 x 16 patient shifts: 32 patients total	HHD program 32 patients
Facility	One	Thirty two
Storage rooms	One	Thirty two
Lab processing stations	One	Thirty two
Nurses	One	Three
Patient care technicians	Four	Thirty two (patient)
Biomed (Cultures, water prep)	One	Thirty two
Facility Administrator	One	Hopefully one

Challenges: Differences between in center versus home hemodialysis

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Staff – patient interactions per month		
Face to Face monthly interactions (Per patient)	ICHD 2 x 16 patient shifts: 32 patients total	HHD program 32 patients
Nursing	13	1-2
PCT	13	Patient is the PCT
Physician / NP	4	1
Dietician	1-4	1
Social Worker	1-4	1
Initial patient training	0	20-30
Staff to staff observations	unlimited	limited

Challenges for HHD

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- More "moving parts" per patient
- Less opportunity for face to face interactions with patients
- Less opportunity to identify patient reported new problems
- Less opportunity to acquire patient data
- Less opportunity to administer intravenous and dialysis related medications
- Less opportunity to observe patient PCT skills

Solution: Broad stroke

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- Cannot manage HHD program like ICHD
  - Manage more like PD program
- Need goals and mission
- Develop communication skills and methods
- Trust – has to be "earned"
- Retraining
  - Scheduled and unscheduled
  - Skill set audits
- Protocols

What is the goal or mission of your program?

1) Achieve a census greater than 10?, 20? or 50 patients?
2) Achieve an annual growth rate greater than 5%? or 10%?
3) **Enable patients to exercise choice of renal replacement therapy (dialysis modality and transplant)?**
4) **Enable patients to successfully do HHD?**
5) **Improve patient QOL – help patients live better?**
6) Help patients live longer?

If you focus on 3,4,5 and (maybe 6) you can achieve 1 and 2.
If you focus on 1 and 2 you might mess up on 3,4,5 and 6

Need to understand patient perspective

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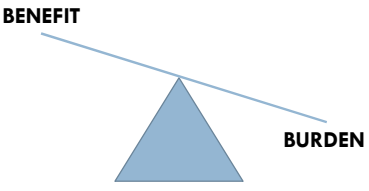
- Why do patients choose HHD?
  - Seek better outcomes (BP, phosphate, volume status)
    - Some but not most
  - Feel better
    - Of course!
  - **They need or want to**
    - **Driven by quality of life!**

Why do patients <u>stay</u> on HHD?



Patient – centric:
Always minimize burden and maximize benefit
Burden = treatment and related "facility" activities!
Treatment plan has to incorporate patient preferences

Growth: patient-centric

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New Patients (CKD education, etc)
- Dropouts (Program Quality)

= GROWTH

New patients are driven to HHD by <u>patient</u> needs
Dropout is a measure of program quality.
Entire team is responsible for program quality

Quality care, program quality and technique survival

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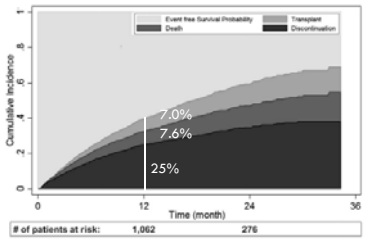

Seshasai RK, et al <u>Am J Kidney Dis.</u> 67(4): 629-637, April 2016.

What is the best way to achieve your goals?

- Take control of your program
  - Medical director = active program advocate
    - Help educate physicians
    - Resource for staff development
- Build a strong team
- Examine every aspect of your program from medical perspective and patient perspective
- Minimizing controllable loss* is a measure of quality

* Controllable loss = Patient dropout censored for transplant and death

Single most important factor for success:

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- **Relationships and Trust!**
- Patient and staff
  - Need to develop trust
  - Need "unconditional, bi-directional communication"
  - Preferred mode of communication when not in clinic
    - Phone, email, text message?
    - Regularly scheduled or as needed
  - Is information effectively communicated and plan executed?
    - Spoken
    - Written
    - Electronically transmitted
    - How do you know information was understood?

Relationships: Staff

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- Nurse to nurse: multi-nurse program
- Physician to nurse: keep each other updated
- Hospital to out-patient dialysis facility (vice versa)
- CKD nurse to dialysis nurse (vice versa)
- Social Worker
- Dietician
- Administrator

Need to keep team together and focused

Build a Strong Team

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- **PATIENTS**
- Nurses
- Nurses
- Nurses
- *Physicians*
- Social worker
- Dietician
- Administrator
- Biomedical engineering
- Administrative assistant
- Patient care technician
- *Interventional radiology*
- *Vascular surgeon*

Patients are the focal point of the team.

Everyone is responsible for treatment plan.

Different patients have different needs.

Team needs to be thoughtful, resourceful, and innovative.

Over time the bench strength of your team may change. Roles, responsibilities and processes may need to change too.

People: Nurses

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- KEY!
- Invest in nursing education
  - Will decrease "hassle" factor
  - Do not rely solely on dialysis provider
- Opportunities for education = any interaction
  - In service
  - Clinic days
  - E-mails
  - Phone calls
- Make sure staffing is appropriate

Implement a treatment plan

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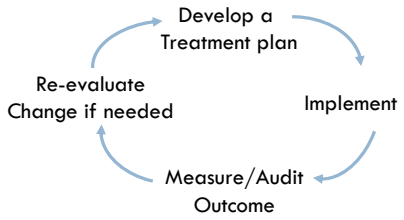

Treatment Plan

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- Appropriate prescription
  - SDHD vs NHD
  - Solute removal
    - Small molecule
    - Middle molecules
  - Fluid removal
- EDW and blood pressure control
- Access care

Prescription: Appropriate for patient lifestyle

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- Provide appropriate dialysis prescription
  - Dialysis dose should be adjusted according to patient clinical status
- STD Kt/V (weekly)
  - Never clinically validated
  - Recent KDOQI recommendation to target STD Kt/V of 2.3 with a minimum dose 2.1. Use a calculation that includes UF and RRF. (Ungraded)
  - The consequence of high Kt/V target is an increase in time of dialysis for most 5 day per week HHD patients and an increase in burden – without proof of any benefit

Typical Treatment Parameters: Home Hemodialysis

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Currently only two machines available for home use

	Traditional Equipment			*NxStage*	
	Fresenius 2008K@home			*Low volume approach*	
	Conventional HD	*SDHD*	*NHD*	*SDHD*	*NHD*
Treatments/ Wk	3	5-6	5-6	5-6	5-6
Treatment Time (Hrs)*	4	2.5-2	6-8	2.5-3	6-8
Qb (ml/Min)	400	400	200-250	400	200-250
Qd (ml/Min)	600-800	600-800	300	**130-200**	**60-80**

*** Minimum 12 hours per week**

There is more to dialysis than Kt/V

- If a patient is not doing well and STD Kt/V is >2.0 they are still not well dialyzed
- If a patient is doing great they are well dialyzed
- Time on dialysis is more important
- If in-center HD patients get 12 hours per week then SDHD patients should get a minimum of 12 hours too (2.5 hours x 5 days per week)
- RRF counts!
- VOLUME!!!!!
  - If patient has significant RRF and interdialytic weight gains are minimal they might be able to do 4 days/week
- Blood pressure control

Traditional technology prescriptions

Short Daily HD	Nocturnal HD
Clearance Qb 400; Qd 600 spKt/V ~ 0.8 -1.1	Clearance Qb 250; Qd 300 spKt/V ~ 1.8 -2.0
Time on therapy 2 hours (6 d/wk); 2.5 (5d/wk)	Time on therapy 6-8 hours (5 d/wk)
Potassium Adjust accordingly	Potassium Adjust accordingly
Bicarbonate Adjust accordingly	Bicarbonate Adjust accordingly
Calcium Adjust accordingly	Calcium Adjust accordingly
Heparin Bolus	Heparin Bolus and maintenance

LDVA*: (NxStage Therapy)

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- Different than traditional HD
- In a way more similar to PD
- LDVA can be applied to any hemodialysis platform
- Goal: efficient use of dialysate

*LDVA = Low Dialysate Volume Approach

Understanding LDVA ("NxStage")

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- Forget everything you know about in-center dialysis
- In center dialysis prescribes "time" of treatment
- LDVA prescription: volume of dialysate, blood flow, flow fraction (and ultrafiltration).
- TIME ON THERAPY IS A DEPENDENT VARIABLE
  - Can be manipulated by adjusting dialysate volume, blood flow, flow fraction and ultrafiltration
- Need to understand "Flow Fraction"

FLOW FRACTION (FF)

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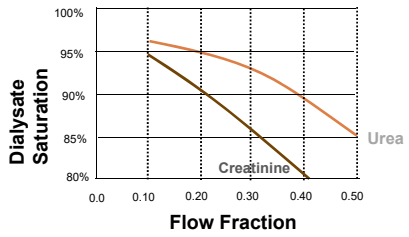
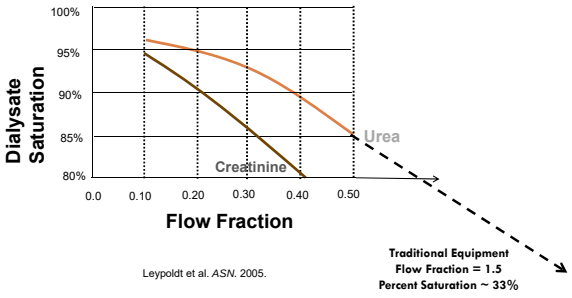
- NxStage therapy terminology
- Q_d/Q_b
- At lower Flow fractions [dialysate flow (Q_d) << blood flow (Q_b)] saturation of dialysate increases (more efficient use of dialysate).
  - When dialysate flows very slowly through the dialyzer there is more time for it to completely saturate with blood

Improving Efficiency by Decreasing Flow Fraction: Q_d/Q_b



Leypoldt et al. *ASN*. 2005.

Improving Efficiency by Decreasing Flow Fraction: Q_d/Q_b



Leypoldt et al. *ASN*. 2005.

Comparison: LDVA vs traditional approach

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	Traditional equipment	LDVA
Dialysate Flow	600	200
Blood Flow	400	400
Time of therapy	2.5 hrs	2.5 hrs
Flow Fraction (FF)	1.5	0.5
Saturation	Low (~ 33%)	High (85%)
Dialysate volume per tx	90 L	30 L
Kt	(90 L)(.33) = **30 L**	(30 L)(.85) = **25.5L**
~sp Kt/V (80 Kg patient)	**= 30/40 = 0.75**	**= 25.5/40 = 0.64**

- Traditional equipment is time efficient and dialysate inefficient
- LDVA is dialysate efficient, but to achieve some time efficiency sp Kt/V is lower

Initial Prescriptions: the easy way for 5 days per week

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- For SDHD:
  - Pick a reasonable dialysate volume according to patient weight
  - Pick a reasonable flow fraction.
  - Then measure spKt/V (URR) and calculate std Kt/V.
    - If you do not achieve target std Kt/V change flow fraction or dialysate volume or both and measure spKt/V and calculate std Kt/V again.
- Example of reasonable initial prescriptions for 5 day per week therapy:

Dialysate volume

Small: (<70 kg)	**20 liters**
Medium: (71-85 kg)	**25 liters**
Large: (86-100 kg)	**30 liters**
>100 kg	**35 liters**

Flow fraction

About 0.40 – 0.5 (40 - 50%)

Manipulate variables to achieve target Kt/V

$$\text{Per Treatment } Kt/V_{urea} = \frac{(D/P_{urea})(\text{Dialysate drain volume})}{V_D\text{Urea (TBW)}}$$

D/P_{urea} is percent saturation and is determined by flow fraction

To increase Kt/V we can:
1) Increase percent saturation (decrease FF)
2) Increase dialysate volume
BOTH strategies will increase time on dialysis

BUT if we generously increase dialysate volume, we could increase FF (increase Q_d and decrease percent saturation) and still achieve target Kt/V without increase in time per treatment.

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Dialysate: Pureflow SL

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Dialysate Concentrates

The PureFlow SL System prepares batches of dialysate in the following formulations and volumes:

Constituents (mEq/L)	SAK-301/401	SAK-302/402	SAK-303/403	SAK-304/404	SAK-305/405	SAK-306/406	SAK-307/407
Lactate	45 mEq/L (45 mmol/	40 mEq/L (40 mmol/L	45 mEq/L (45 mmol/L)	45 mEq/L (45 mmol/L)	45 mEq/L (45 mmol/L)	45 mEq/L (45 mmol/L)	40 mEq/L (40 mmol/L)
Potassium	1 mEq/L (1 mmol/L)	1 mEq/L (1 mmol/L)	1 mEq/L (1 mmol/L)	2 mEq/L (2 mmol/L)	1 mEq/L (1 mmol/L)	2 mEq/L (2 mmol/L)	1 mEq/L (1 mmol/L)
Sodium	140 mEq/L (140 mmol/L)						
Calcium	3 mEq/L (1.5 mmol/L)	3 mEq/L (1.5 mmol/L)	3 mEq/L (1.5 mmol/L)	3 mEq/L (1.5 mmol/L)	3 mEq/L (1.5 mmol/L)	3 mEq/L (1.5 mmol/L)	3 mEq/L (1.5 mmol/L)
Magnesium	1 mEq/L (0.5 mmol/L)						
Chloride	100 mEq/L (100 mmol/L)	105 mEq/L (105 mmol/L)	100mEq/L (100mmol/L)	101 mEq/L (101 mmol/L)	100 mEq/L (100 mmol/L)	101 mEq/L (101 mmol/L)	105 mEq/L (105 mmol/L)
Glucose	100 mg/dl						
Batch Size	60 L	60 L	50 L	60 L	40 L	50 L	50 L

32 Dialysate: Premixed sterile bags

Premixed sterile dialysate, 5 L bags

Constituents	RFP-204	RFP-205	RFP-207	RFP-209	RFP-211
Lactate	40 mEq/L (40 mmol/	35 mEq/L (35 mmol/L	45 mEq/L (45 mmol/L)	45 mEq/L (45 mmol/L)	40 mEq/L (45 mmol/L)
Potassium	1 mEq/L (1 mmol/L)	3 mEq/L (3 mmol/L)	1 mEq/L (1 mmol/L)	2mEq/L (1mmol/L)	
Sodium	140 mEq/L 140 mmol/L)				
Calcium	3 mEq/L (1.5 mmol/L)				3.5mEq/L (1.75 mmol/L)
Magnesium	1 mEq/L (0.5 mmol/L)				
Chloride	105 mEq/L (105 mmol/L)	112 mEq/L (112 mmol/L)	100 mEq/L (100 mmol/L)	101 mEq/L (101 mmol/L)	106 mEq/L (106 mmol/L)
Glucose	1.1g/L				
Osmolarity (calculated)	294 mOsmol/L	298 mOsmol/L	294 mOsmol/L	296 mOsmol/L	296 mOsmol/L

Anticoagulation

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- SDHD
  - Bolus heparin only
  - About 40-50 units/Kg
- NHD
  - Need cartridge with heparin line
  - Need external heparin pump
  - Bolus 40-50 units/kg and Maintenance of 1000-1500 units/hr. End one hour prior to end of treatment

LDVA (NxStage) Prescription

SDHD	Nocturnal HD
Time on therapy 2:30- 3 hours	Time on therapy 6-8 hours
Clearance 20-30 Liters Qb 400-450; Flow Fraction 30-50% (Qd 100-200)	Clearance 20-30 Liters Qb 250-300; Flow Fraction 30-50% **Qd: Adjust to achieve target sleep time!**
Potassium 1.0 meq/L	Potassium 1.0 meq/L
Bicarbonate (by metabolism of lactate) 40 or 45 meq/L	Bicarbonate (by metabolism of lactate) 40 or 45 meq/L
Calcium 3.0	Calcium 3.0
Heparin Bolus	Heparin **Heparin Pump**

SDHD: Short-term BP Control

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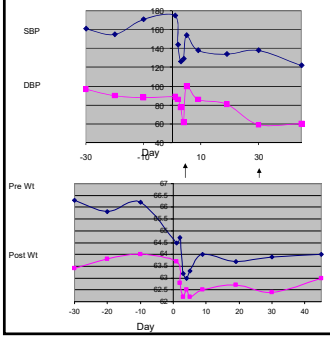

Meds
Day 0
Nifedipine XL 90 mg BID
Labetolol 400 mg BID
Day 4
Nifedipine XL 90 mg QD
Labetolol 200 mg BID
Day 30
NONE

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SDHD: Long-term BP Control

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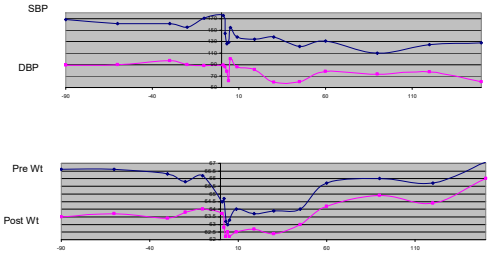

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Short and Long term BP and Volume Management

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- All in-center HD patients are volume expanded
- Normotensive in-center HD patients will become hypotensive on daily dialysis unless adjustments are made
- Anticipate decrease need for BP meds
- Dry weight is dynamic

Short Term BP and Volume Control

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- Training
  - Review BP medication regimen
  - If pre-dialysis BP is normal then decrease BP medication regimen even before you start training
  - Short term hypotension is more dangerous than mild long term BP elevation
  - Every 1-3 days communicate with training nurse to adjust BP medication regimen
  - Decrease EDW during training after BP medication regimen is appropriately decreased

Long term BP and Volume Control

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- Short term hypotension is more dangerous than long term BP elevation
- Review flow sheets
- Teach nurse and patient to call if any trend down in pre/post BP
- Anticipate gain in dry weight
- If patient is on more than one BP medication reevaluate EDW as well as adequacy of dialysis therapy

Quality Care: Medical management

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- I think the four most important elements to minimize controllable loss are:
  - **Access:** AVF or AVG vs CVC
  - **Infections:** Bacteremia and buttonhole infections
  - **Prescription:** appropriate for patient lifestyle
  - **Patient support and minimize burden:** individualize care

Incident HHD patients in U.S.

Rivara, MB, et al, Clin J Am Soc Nephrol 11:298-307, 2016

- 1052 patients
  - 526 CVC, 526 AVF/AVG
- Propensity score matched cohort
- CVC higher risk mortality
  - HR 1.73; 95% CI 1.18-2.54)
- CVC higher risk hospitalization
  - HR 1.19; 95% CI 1.02-1.39

Vascular access in the home

- Though we prefer AVF, AVG is OK and CVC may be necessary
- Circumstance may dictate necessity and should be addressed on case by case basis
  - Trisomy 21 patient with CVC
  - Ventilator dependent COPD patient with limited survival

Vascular access management in the home

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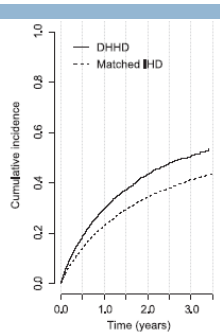
- Basic examination skills
  - Inspect - Red, change in skin color, drainage or pain, new aneurysm
  - Thrill – pulsatile?
  - Bruit – change in pitch?
  - Augment in pulse?
  - Elevate arm – does AVF decompress/collapse?

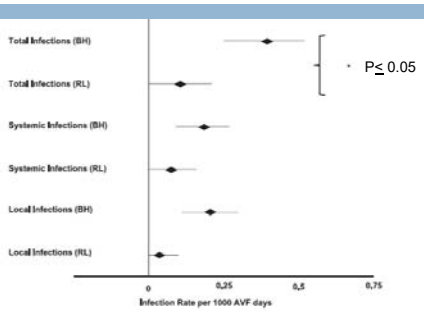
Infection: more frequent home hemodialysis Weinhandl, AJKD 65:98, 2014



Infection related hospitalizations

Hazard ratio for bacteremia and sepsis: 1.35 (1.24-1.46)

Buttonhole associated with increased infection (cohort study)



Muir, et al *Clin J Am Soc Nephrol* 9: ●●●–●●●, 2014. doi: 10.2215/

Why is infection rate higher and what is the solution?

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- Huge variability and error in cannulation technique
  - Wash access
  - Skin antisepsis
  - Mask
  - Buttonhole scab removal
  - Antibiotic prophylaxis
  - Re-training
- ZERO percent of nurses and patients teach or perform every step of cannulation correctly

Spry, et al Hemodialysis International, 2014

Cannulation errors

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- Masks
  - 90% of patients with CVC use masks
  - 30% of patients with AVG/AVF use masks
  - 50% nurses train AVG/AVF patients to use masks
- Skin antisepsis
  - 77-90% of nurses do not train patients according to manufacturer recommendations for antiseptic agent
- Retraining
  - 64% nurses do not require patients to demonstrate cannulation technique more than once a year

Spry, et al Hemodialysis International, 2014

Prophylactic antibiotics

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- 56 patients observed for Staph Aureus bacteremia pre and post mupirocin prophylaxis
  - 10 episodes of SA infection (pre mupirocin) O.R. 6.4
    - 0.32 infections per 1000 AVF days
    - Metastatic complications in 4 (pneumonia x 2, septic arthritis, fatal C3 abscess)
  - 2 episodes of SA infection (post mupirocin)
  - 0.03 infections per 1000 AVF days
    - Both patients non adherent with mupirocin and stopped 3 weeks prior to infection.

Nesrallah et al : CJASN 5:1047-53, 2010

How do we avoid infectious and non-infectious access complications in home hemodialysis patients?

- Training, training and re-training
  - Ongoing and regularly scheduled
- Good QA and surveillance program
- Prophylactic antibiotics

Patient challenges: Burden of therapy

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- Home patients are a heterogeneous group
- Home patients have many burdens
  - Performing HD
  - Managing supplies
  - Managing time
- Patients report multiple factors that contribute to discontinuation
  - Inadequate social support
  - Organization and routine with modality
  - Comfort level with technical aspects of modality
  - Realistic expectations and positive attitude

Patient Burden
Solution: support, decrease burden by individualized care.

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- Can't just train, send patient home and see in clinic monthly
- HHD team needs to know more about patients and understand other circumstances in their lives.
- Each member of the team has the opportunity to discover how HHD impacts quality of life.
- Team as a whole needs to identify factors that negatively impact patients experience with HHD
- Need pre-clinic and monthly patient care conference with entire team

Questions?

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