



The Law of Unintended Consequences

**Zimbabwe elephant crushes trophy
hunter, killing him**

Tests I Wish You'd Never Ordered (Choosing Wisely ©)

G Blackburn DO, MACOI

Moderator, (Infectious Disease)

ACOI's 77th Annual Convention and Scientific
Sessions

October, 2017

Washington, DC

Disclosures: none

Definition of a well person:

Definition of a well person:
“someone who has not
been completely worked
up”

G. Kolata 2001

**WE HAVE MET
THE ENEMY
AND HE IS US.**



Medical Error Is Third Leading Cause of Death in US

Medical error is the third leading cause of death in the United States, after heart disease and cancer.....say authors Martin Makary, MD, MPH, professor of surgery, and research fellow Michael Daniel, from Johns Hopkins University School of Medicine.

BMJ 2016;353:i2139



Sept 22, 2015

Improving Diagnosis in Health Care, a continuation of the landmark Institute of Medicine reports finds that diagnosis—and, in particular, **the occurrence of diagnostic errors—has been largely unappreciated.....** The committee concluded that **most people will experience at least one diagnostic error in their lifetime, sometimes with devastating consequences.**

Our Previous Opinionated Panelists

- Mark Baldwin, DO (Nephrology)
- Timothy Barreiro DO, MPH (Pulm)
- Jack Bragg, DO (Gastroenterology)
- John Bulger, DO (Internal Medicine)
- Martin Burke, DO (Cardiology)
- Robert Chilton, DO (Cardiology)
- Patrick Cullinan, DO (ICU)
- Mitchell Davis, DO (Gastroenterology)
- Robert DiGiovanni DO, Rheumatology
- Gregg Friess, DO (Hematology/Oncology)
- Scott Girard, DO (Internal Medicine)
- Robert Hasty, DO (Internal Medicine)
- Leonard Hock, DO (Geriatrics)
- Kevin Hubbard, DO (Hematology/Oncology)
- Marc Kaprow DO (Palliative Care)
- Bryan Martin, DO (Allergy/Immunology)
- Jack Prior, DO (Nephrology)
- Robbie Rose, DO (Neurology)
- John Sutton, DO (Endocrinology)
- Paul Wenig, DO (Rheumatology)
- Sandra Willsie, DO (Pulmonary / Critical Care)*

*Deceased

- Michael James DO, FACOI
Cardiology (CCOM, Class of '69)
- Stephen Sokalski DO, FACOI
Infectious Disease (CCOM, Class of '69)
- William Peppo DO, FACOI
Pulmonary/Critical Care
(CCOM, Class of '69)

Primum non nocere.....

Someday, YOU - and every
single person you know and
love - will be a patient

TOMORROW
STARTS
TODAY.

TESTS I WISH YOU HAVE NEVER ORDERED
ACOI 2017 ANNUAL CONVENTION AND SCIENTIFIC SESSIONS

BLOOD CULTURE ORDERS

STEPHEN J SOKALSKI DO FACOI FSHEA

CULTURE ORDERS FOR SEPSIS

- NURSE: “DOCTOR YOUR ICU PATIENT HAS A FEVER OF 38.8 DEGREES C. WHAT DO YOU WANT ME TO ORDER?”.
- DOCTOR: “DRAW TWO BLOOD CULTURES FROM THE CENTRAL LINE NOW AND FOR A FEVER GREATER THAN 38.5. START GODAMYCIN.”

INDICATIONS FOR BLOOD CULTURES

1. CLINICAL FEATURES OF SEPSIS INCLUDING TACHYCARDIA, TACHYPNEA, INCREASED OR SUBNORMAL TEMPERATURE, CHANGE IN SENSORIUM.
2. SUSPICION OF ENDOCARDITIS
3. FUO
4. LEUCOCYTOSIS
5. SYSTEMIC AND LOCALIZED INFECTIONS

RESULTS

- IN THE NEXT 24 HOURS 3 DIFFERENT SETS OF BLOOD CULTURES ARE DRAWN.
- WHAT'S WRONG WITH THIS PICTURE?

BLOODSTREAM INFECTIONS AND CULTURES

- BLOOD VOLUME IS THE MOST IMPORTANT VARIABLE IN RECOVERING BACTERIA FROM BLOOD
- 20-30 ML PER CULTURE SET
- CHILDREN GRADUATED VOLUMES
- IDEAL TOTAL # OF SETS IS 2-4
- IN ACUTE SEPSIS 2 BLOOD CULTURES FROM 2 SITES DRAWN AT ONCE IS ADEQUATE

BLOOD CULTURES

- BLOOD CULTURES SHOULD BE DRAWN BEFORE ABX ARE STARTED
- CATHETER-DRAWN BLOOD CULTURES = HIGHER CONTAMINATION RATE
- DO NOT SUBMIT CATHETER TIPS FOR CULTURE WITHOUT AN ACCOMPANYING BLOOD CULTURE BY VENIPUNCTURE
- NEVER REFRIGERATE BLOOD CULTURES PRIOR TO INCUBATION

NUMBER OF CULTURES

- CUMULATIVE YIELD OF TRUE PATHOGENS
- FIRST BC = 73% TO 80%
- SECOND BC = 80% TO 89%
- THIRD BC = 95% TO 98%
- FOURTH BC = 99% TO 100%
- ONE BLOOD CULTURE IS RARELY ADVISABLE SINCE INTERPRETATION IS DIFFICULT

BLOOD CULTURES

- CONTAMINATION IS COMMON (0.6% TO > 6%)
- THIS IS COSTLY AND CONTRIBUTES TO OVER TREATMENT AND MISDIAGNOSES
- METICULOUS CARE AND SKIN PREPARATION MUST BE TAKEN PRIOR TO EACH VENIPUNCTURE OR CENTRAL LINE BLOOD DRAW

FALSE POSITIVE BLOOD CULTURES

- 20% INCREASE IN LAB CHARGES
- 39% INCREASE IN ANTIBIOTIC CHARGES
- HALF THE PATIENTS WITH FALSE POSITIVE BLOOD CULTURES WERE TREATED WITH ANTIBIOTICS OFTEN VANCOMYCIN (\$1000 PER PATIENT).

BLOOD CULTURES

- CONSENSUS GUIDELINES AND EXPERT PANELS RECOMMEND PERIPHERAL VENIPUNCTURE AS THE PREFERRED METHOD
- LESS LIKELY TO BE CONTAMINATED THAN BLOOD DRAWN FROM AN INTRAVASCULAR DEVICE
- CHG IS SUPERIOR TO POVIDONE-IODINE FOR SKIN DISINFECTION
- 30 SECONDS DWELL FOR DISINFECTION

CATHETER DRAW VS PERCUTANEUS

- 15% TO 25% OF CVC ARE COLONIZED
- SENSITIVITY OF CATH DRAWS 89% V 78% PERIPHERAL WITH PPV OF 63% CATH DRAWS V 73% PERCUTANEUS
- CONSIDER DRAWING ONE FROM CATH AND ONE PC
- WHEN 2/2 BC POSITIVE, PPV 98% IF BOTH FROM VEIN, 96% IF ONE FROM VEIN AND ONE FROM CATH AND ONLY 50% IF BOTH FROM CATHETER.

ADDITIONAL BLOOD CULTURES

- DRAW ORIGINAL BLOOD CULTURES FROM AT LEAST 2 SEPARATE SITES PRIOR TO STARTING ANTIBIOTICS
- ENDOCARDITIS HAS CONTINUOUS BACTEREMIA NO MATTER WHEN DRAWN. ALL WILL BE POSITIVE
- NO FURTHER BCS FOR 48 HOURS
- MAY CHECK TO SEE IF BACTEREMIA IS GONE AFTER 48 HOURS (ENDOCARDITIS, STAPH)

CR-BSI

- DIAGNOSIS OF CLABSI IS USUALLY BY EXCLUSION
- A MICROBIOLOGIC GOLD STANDARD FOR DIAGNOSIS DOES NOT EXIST
- NO FIRM CONCLUSIONS FOR RELATIVE MERITS OF DIAGNOSTIC TECHNIQUES
- FIRST IS DOCUMENTATION OF BACTEREMIA
- CATH TIP CULTURE ALONE, RELEVANCE IS UNKNOWN

CR-BSI

- USUALLY THE DIAGNOSIS OF CLABSI REQUIRES EXCLUSION OF OTHER SOURCES
- ROUTINE CULTURE OF CATHETER TIPS AT REMOVAL HAS NO VALUE
- TIME TO POSITIVITY MAY BE USEFUL IF THE DEVICE BECOMES POSITIVE > 2 HOURS BEFORE THE VENIPUNCTURE.
- QUANTITATIVE BC $> 5X$ FROM PORT VS PERIPHERAL MAY BE USEFUL

CONTROL OF FALSE POSITIVES

- DISCOURAGE BLOOD CULTURE DRAWS IN PATIENTS WITH LOW RISK
- DISINFECTION OF CATHETER SITES MAY BE LESS EFFECTIVE THAN PERCUTANEUS SITES.

Outbreak of *E. cloacae*
and *K. oxytoca* associated
with an Outpatient Chemotherapy Center

John Watson MD
CDPH

Lab Results

- 112 cultures drawn
- 58 patients exposed to flush 2/9 – 3/3
- 54 during period 2/17 – 3/3
- 27 confirmed cases
 - 2 *K. oxytoca* only
 - 20 *E. cloacae* only
 - 5 infected with both organisms

The Outbreak

- CDPH contacted early March:
 - 13 cases of bacteremia among attendees at a Southside chemotherapy center
 - 10 with *Enterobacter cloacae*
 - 2 with *Klebsiella oxytoca*
 - 1 with both organisms

Results, cont'd

- 18 presented with symptoms, 9 identified by blood culture surveillance
- All cases received saline flush during the period 2/17-3/3

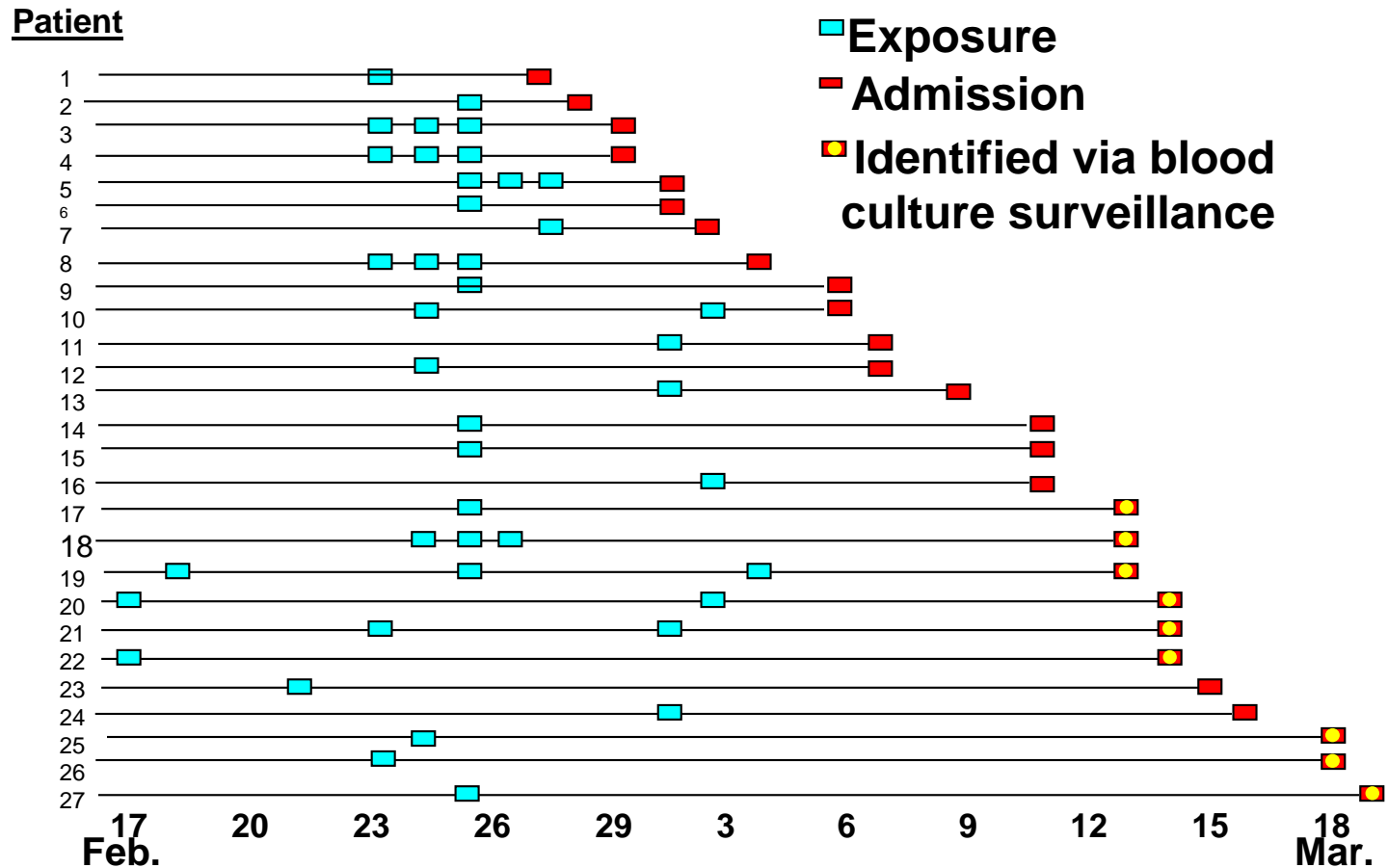
Environmental Sampling

- Saline (opened and unopened bags)
- Dextrose (unopened bags)
- Saline and heparin predrawn syringes
- Tubing (used and unused)
- Swabs of sinks, toilet, doorhandles
- Hand lotion, chemotherapy, disinfectant
- Artificial fingernails of nurse

Summary

- Saline flushes most likely contaminated with *Enterobacter cloacae* and *Klebsiella oxytoca* from 2/17 – 3/3
- 27/54 (50%) exposed to flush during this period developed bacteremia
- Treatment of infections successful

Cases, by Dates of Exposure and Admission



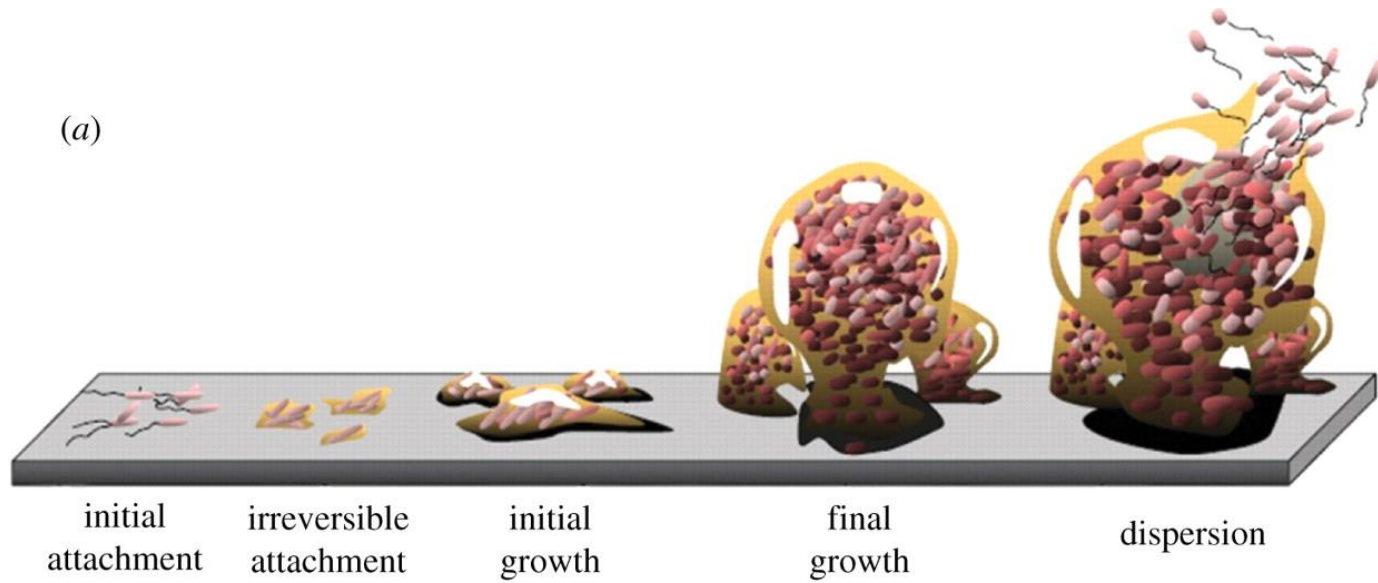
Summary

- Saline flushes most likely contaminated with *Enterobacter cloacae* and *Klebsiella oxytoca* from 2/17 – 3/3
- 27/54 (50%) exposed to flush during this period developed bacteremia
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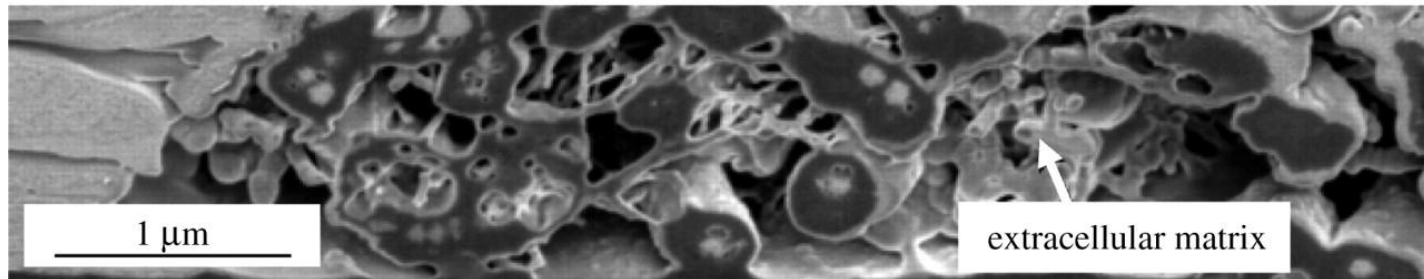
Bio

sample

(a)



(b)



Gregory D. Bixler, and Bharat Bhushan Phil. Trans. R. Soc. A
2012;370:2381-2417

This journal is © 2012 The Royal Society

Epidemiology and Prevention of Bloodstream Infections

- Hand hygiene
- Maximal sterile barrier precautions
- Chlorhexidine rather than povidone-iodine for skin antisepsis
- Avoiding femoral access
- Single lumen if possible
- Remove catheter as soon as possible
- Good work organization
- No guidewire exchange
- No routine catheter change

Incidence density

Events per 1000 device-days

Central venous catheter (CVC)

2.7/1000 catheter-days

PICCs

2.1/1000 catheter-days

Tunneled CVCs

1.6/1000 catheter-days

Peripheral venous catheters

0.5/1000 catheter-days

Implantable port systems

0.1/1000 catheter-days

Risk For
CLABSI

Epidemiology and Prevention of Bloodstream Infections

Insertion Site

RR

Internal jugular access	1.0-3.3	
Subclavian access		0.4-1.0
Femoral access	3.3-4.8	

However: no difference of catheter colonization (40.8 vs. 35.7 per 1000 catheter-days) and CLABSI (2.3 vs. 1.5 per 1000 catheter-days) hemodialysis catheters

Parienti. *JAMA* 2008;299:2413

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The COPD patient that you wish was never placed on Oxygen

William Peppo, DO FACOI
Colton Erskine, OMSIV
Arizona College of Osteopathic Medicine
Midwestern University
ACOI 2017
Washington DC

Without this,
The need for
supplemental
Oxygen would be
minimal



CARTOONSTOCK
.com

Search ID: trhn101

HARRIS

Objectives

- Review of office patients with COPD on Oxygen therapy
- Discuss the indications for oxygen therapy in COPD patients
- Identify COPD patients who would benefit from Oxygen therapy during ambulation
- Discuss the prognosis of COPD with long term Oxygen therapy
- Discuss the impact of intermittent or continuous Oxygen therapy on COPD patients
- Conclusions and recommendations

Two recent patients: first patient

- 81 year old female referred to the office for re-certification of her O2
- Recently moved to Arizona from NY.
- History of COPD/Bronchiectasis on nasal O2 for 5 years. Initially placed on O2 during a hospitalization for aspiration pneumonia. She uses her O2 most of the time. She is on daily ICS/LABA and LAMA inhaled therapy with sporadic albuterol use.
- Resting SpO2 96% on 2lpm August 2017
- Her SpO2 was assessed on ambient air and during a 6MWT

TIME MINS	SPO2	HR	# OF LAPS 95 FT/ LAP
REST	95% RA	83	0
1	93% RA	95	1
2	92% RA	101	2
3 (Dizzy)	90% RA	101	3
4	93% RA	100	4
5	92% RA	102	5
6	89% RA	91	6
RECOVERY 1	94% RA	100	Rest
RECOVERY 2	93	88	Rest

LIMITING FACTOR TO THE TEST:

SOB **LOW SPO2**

August 14, 2017

6MWT

Prior records: first patient

- 6/10/2014 office notes
- SpO2 on 3lpm nasal O2 97%
- Ambulation: start 94% RA and did not drop below 94%
- Physician stated in records: “I don’t think that she needs supplemental O2 at this point, but she continues to use it”. (6/10/2014)
- What do you do about her supplemental O2?
- Discontinue it
- It can’t be certified

Second patient

- 69 year old male with a history of severe COPD and multiple hospitalizations for COPD exacerbations and pneumonia seen in the office
- March 2017 he required ventilator care for his COPD exacerbation. He was discharged home on supplemental O₂. He only uses it sporadically with no regular use. He was hospitalized again in July, 2017 for possible aspiration pneumonia
- He has a chronic cough and sputum with wheezing. He can do his ADL's without requiring his supplemental O₂
- Inhaled therapy: ICS/LABA, LAMA, albuterol

Second patient

- Office visits since June 2017:
- All pulse oximetry readings taken on ambient air
- 6/19/17 SpO2 92%: initial office visit
- 7/3/17 SpO2 93%: FU visit to review lab and Chest CT results
- 7/19/17 SpO2 89% office visit after another hospitalization
- 8/28/17 SpO2 96%

- He still has his home O2
- What do you tell him to do about his supplemental O2 use?
- It won't be certified for continued use.

Tip off that
supplemental
O₂ may not be
needed

SpO₂ > 93 % on
supplemental
O₂



SpO2 94% at
rest

Why does
she have
O2?

Is she using
it?

Who is
paying for



Patients on Oxygen Therapy in Our Pulmonary Office:
7/2016-7/2017

101 Patients with COPD had a SpO₂ ranging from SpO₂ 83-96 on room air at rest

- 35 were not on home oxygen
- 66 on home oxygen
 - Of these 29/66 had an SpO₂ >88% RA at rest
 - 15/29 of which had the following reasons for oxygen
 - 8 had nocturnal desaturation
 - 7 had exercise desaturation
 - 14/29 were unaccounted for and no identifiable reason for remaining on oxygen

Patients on Oxygen Therapy in Our Office: 7/2016-7/2017

29/66 SpO₂ > 88% at rest on room air

37/66 hypoxemic patients on oxygen, 19 met the standard criteria with a SpO₂ \leq 88% ambient air at rest.

The remaining patients who have home O₂ will need to undergo re-evaluation to ensure that they still meet the criteria for oxygen therapy.

68 COPD patients with a resting SpO₂ >89% 6MWT

- 5 did not desaturate from their resting SpO₂
 - 41 had an exertional desaturation, but > 89%
 - Of the 6 that continued oxygen therapy only 2 noted symptomatic improvement
 - 22 had an exertional desaturation < or equal to 88%
 - All 7 initiated on oxygen noted symptomatic improvement
- 9/68 noted symptomatic improvement with the use of O₂

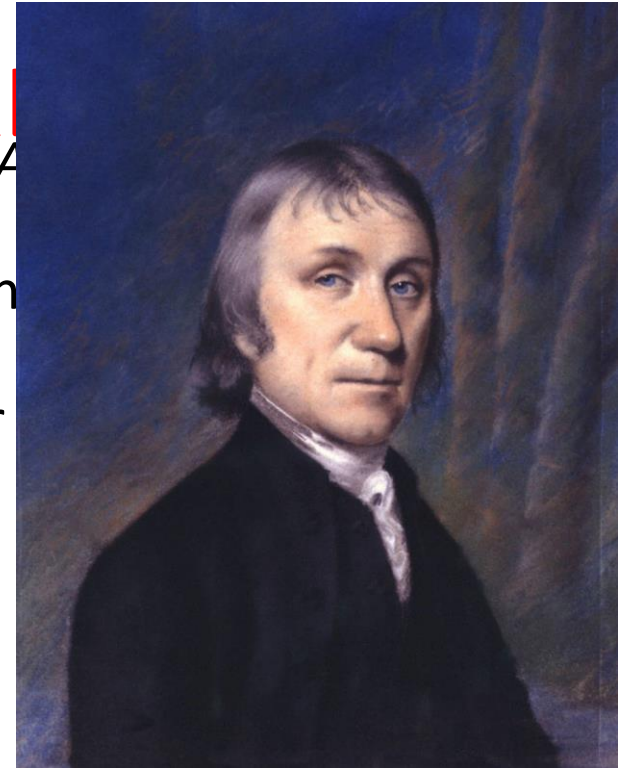
Did they need supplemental O₂?

Summary of office patients with COPD on Oxygen therapy

- Many patients didn't meet the Medicare guidelines for the use of Long term Oxygen therapy (LTOT)
- Patients are given supplemental O2 for various reasons. When patients are seen in the office and have home O2, it isn't always clear why they were given it and who initially ordered it.
- Once patients have home O2, it is difficult to discontinue it. They don't want to give it up. They feel it is a safety net for them. If their use of home O2 can't be recertified and they have to pay for it, they reluctantly discontinue it.

Joseph Priestley: 1733 - Feb 06, 1804
The Person Who Started It All

- *Experiments and Observations on different kinds of Air*
 - Six volumes published between 1772-1790¹
 - An ingenious apparatus: mouse in a bottle + burned red mercury oxide = sustained life
 - He termed the unknown gas dephlogisticated air
 - Became known as Oxygen



- Joseph Priestley FRS was an 18th-century English theologian, English Dissenters clergyman, natural philosopher, chemist, innovative grammarian, multi-subject educator, and liberal political theorist who published over 150 works.

COPD in the United States

- 30 million Americans are affected by COPD ³
- Approximately 120,000 people die annually from COPD ⁴
- Smoking cessation and long term oxygen therapy (LTOT) are the only treatments that reduce mortality in COPD patients

Impact of Oxygen use in COPD patients

- Roughly 1 million Medicare patients receive LTOT annually ⁴
- At a cost of over \$2 billion per year in Medicare reimbursements ⁴
- Due to the high cost and financial burden of oxygen therapy, it is incumbent for us to ensure that a patient meets the criteria for expected mortality benefit.

Impact of Oxygen on COPD patients

- Long term oxygen therapy (LTOT) is defined as the use of oxygen for at least 18 hours/day to prevent the physiological effects of prolonged hypoxemia that reduce longevity ⁴

Pulmonary hypoxic vasoconstriction → Pulmonary hypertension → Cor pulmonale/decreased cardiac output

- 1) increased heart rate
- 2) increased stroke volume
- 3) increased EPO and polycythemia
- 4) tissue hypoxia and poor perfusion

End result = cardiovascular stress, organ dysfunction and neurocognitive decline

Complications of Oxygen

- Another reason to ensure patients meet the criteria before prescribing:
 1. Burn related injuries
 2. Falls from line entanglement
 3. Respiratory depression ($SpO_2 >92$)
- My experience:
 1. Motor vehicle accident (truck) patient reached down to turn on his O2 while driving and hit a tree: sustained MTI's and eventually died
 2. Hoarding: DME company would not leave O2 at the home (fear of combustion)
 3. Anxiety due to perceived removal of O2 or device failure
 4. Facial burns due to smoking while using O2
- Currently no evidence that long term oxygen at therapeutic levels has adverse effects ⁴



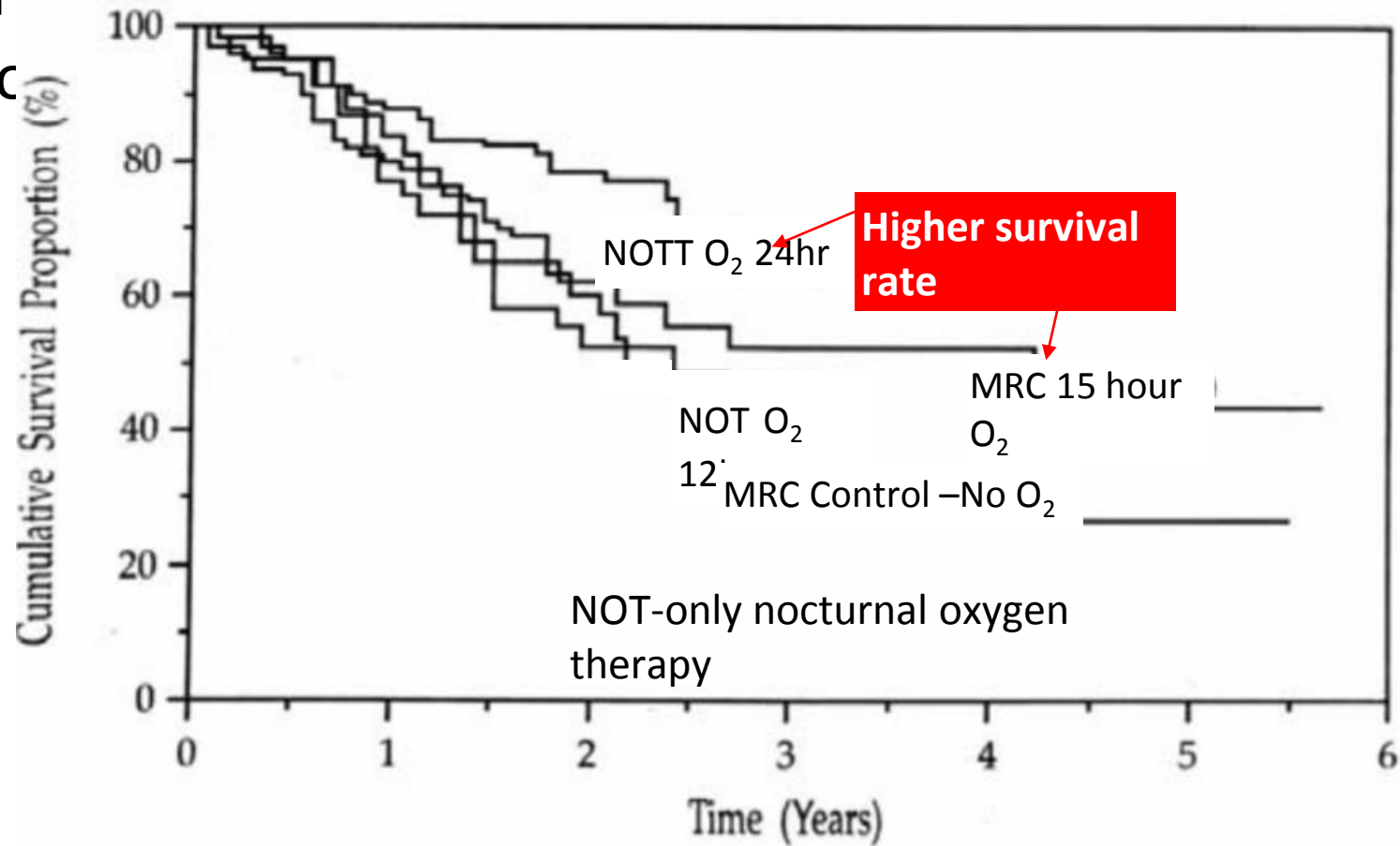
Early Benefits and Indications for LTOT

- Two studies from the 1980s correlated long-term oxygen use with reduced mortality in COPD patients that had severe resting hypoxemia ⁷
 1. The Nocturnal Oxygen Therapy Trial (NOTT)
 - 203 COPD patients randomized to continuous (24hr) oxygen vs nocturnal (12hr) oxygen
 - Mortality in nocturnal 1.94 times continuous (P =0.01) ⁸
 2. The Medical Research Council (MRC) Long term Domiciliary Oxygen Therapy Trial
 - 87 COPD patients randomized to 15 hours oxygen therapy or no oxygen therapy
 - Five year mortality = 19/42 oxygen therapy group vs 30/42 control group ⁹

Early Benefits and Indications for LTOT

- Current LTOT Criteria derived from inclusion criteria of NOTT and MRC: (stable COPD patient)
 - Severe hypoxemia = $\text{PaO}_2 < 55$ mmHg or $\text{SaO}_2 < 88\%$ on RA
 - PaO_2 56-59 mmHg or $\text{SaO}_2 < 90\%$ with one of the following:
 1. Pulmonary hypertension
 2. CHF/cor pulmonale
 3. Hematocrit $> 56\%$

Citation 7. Combined data from the NOTT and MRC Study showing the improvement in survival proportional to the duration



1980 STUDY on Continuous O₂ therapy trial in COPD
(Long term Oxygen therapy – LTOT)

- Initial studies did not address the effect of oxygen on:
 1. Moderate hypoxemia: Spo₂ 89-93%
 2. Exercise – desaturation, dyspnea, and tolerance
 3. Nocturnal Desaturation
 4. Quality of life

The Long-Term Oxygen Treatment Trial (LOTT 2016) ¹⁰

- A Randomized Trial of Long-Term Oxygen for COPD Patients with Moderate Resting Desaturation (Spo₂ 89-93%) and Exercise Desaturation (drop below 90% for at least 10 seconds during 6 minute walk test)
 - 738 patients followed from Jan 2009 – August 2014 (SpO₂ 89-93)
 - 133 resting desaturation, 319 exercise desaturation (<90), 286 both
 - Exercise desaturation patients breakdown:
171 Spo₂ <86, 208 Spo₂ 86-88, 203 Spo₂ >88

The Long-Term Oxygen Treatment Trial (LOTT 2016) ¹⁰

- No significant difference in:
 1. Mortality (1^o outcome 0.90 hazard ratio, p 0.52)
 2. Time to first hospitalization
 3. Exercise tolerance (6MWT)
 4. Quality of Well-Being Scale (QWB), anxiety, depression scales

Citation 10. Data from the LOTT showing no significant difference in death rate and first hospitalization rate between the oxygen treatment group and the control group.

Table 2. Primary Composite Outcome of Death or First Hospitalization for Any Cause and Composite Events in the Intention-to-Treat Population.*

Outcome	No Supplemental Oxygen (N=370)	Supplemental Oxygen (N=368)	Hazard Ratio (95% CI)	P Value
Primary outcome				
Death or first hospitalization for any cause			0.94 (0.79–1.12)	0.52
No. of events	250	248		
Composite rate per 100 person-yr	36.4	34.2		
Primary-outcome component events				
Death				
No. of deaths	73	66		
Rate per 100 person-yr	5.7	5.2		
First hospitalization for any cause				
No. of first hospitalizations	237	229	0.92 (0.77–1.10)	0.37
Rate per 100 person-yr	34.5	31.6		

Mortality and first hospitalization rates slightly lower in oxygen group but not statistically significant

Mortality and Exercise Desaturation (predictor of future O2 needs)

- Ignacio (2011): Of 83 COPD patients with a resting SpO₂ > 93%, 53 patients (65%) with exercise desaturation <90% within the first minute of exercise developed severe resting hypoxemia (SpO₂ <88%) and required LTOT at 5 year follow-up¹⁷

Mortality and Exercise Desaturation

Conclusion:

- Early and severe exercise desaturation are poor prognostic factors in COPD that suggests disease progression and may predict the future need for LTOT ^{12,17}
- However, no current study correlates the use of oxygen in patients with exercise desaturation <88% with reduced mortality rates ^{10,11}

Exercise Tolerance as a Predictor of future Oxygen use

- The LOTT (2016): No difference in distance walked during 6 minute walk test while on long term oxygen in 738 COPD patients with moderate resting hypoxemia (SpO₂ 89-93%) and exertional desaturation (SpO₂ <90%) **suggesting no benefit with oxygen in those with stable COPD**

Exertional Dyspnea

Conclusion

- Dyspnea may discourage exercise which promotes deconditioning. Deconditioning may exacerbate exertional dyspnea, further limiting activity and diminishing quality of life ⁷
- If indicated, continuous oxygen during exercise is likely more beneficial than short-bursts before or after ¹³⁻¹⁵
- The role of oxygen in relieving dyspnea is controversial, thus, use in patients who with severe resting hypoxemia ($\leq 88\%$) and/or severe activity limiting dyspnea is most appropriate

Summary of indications for Oxygen use LTOT-long term oxygen therapy (COPD)

1. Due to the significant cost of treatment, decisions to start LTOT should be based on mortality benefit and improvements in quality of life
2. All patients meeting the Medicare standard criteria should be placed on oxygen: all others, O₂ should be discontinued and patients should be monitored for future O₂ requirement.
3. Exercise desaturation is an indication for continued monitoring, but not a sole indication to start oxygen therapy. Desaturations <90% within 1 minute, should prompt re-evaluation of resting SpO₂ to determine if a patient meets Medicare criteria for oxygen.

Maybe he doesn't need oxygen



Recent articles about O2 use that may be of interest and not listed in the references

- [Physiological Effects of Chronic Hypoxia](#)
- May 18, 2017 West J.B.
- N Engl J Med 2017; 376:1965-1971
- [Oxygen Therapy in Suspected Acute Myocardial Infarction](#)
- August 28, 2017 Hofmann R., James S.K., Jernberg T., et al.
- 10.1056/NEJMoa1706222 Online
- [British Thoracic Society Guideline for oxygen use in adults in healthcare and emergency settings](#)
- O'Driscoll BR, Howard LS, Earis J, et al. BMJ Open Resp Res 2017;4: e000170. doi:10.1136/ bmjresp-2016-000170

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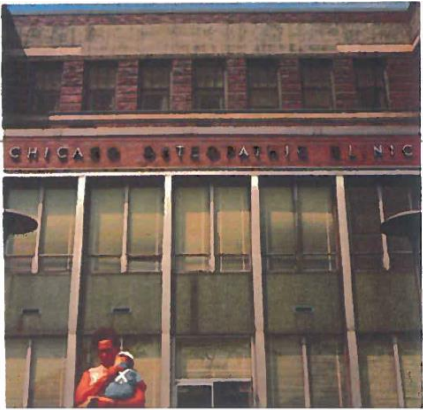
CARDIOLOGY TESTS I WISH I NEVER ORDERED

Just give me a stethoscope and a patient and I'll be
happy and the cost of medicine will be reduced
significantly

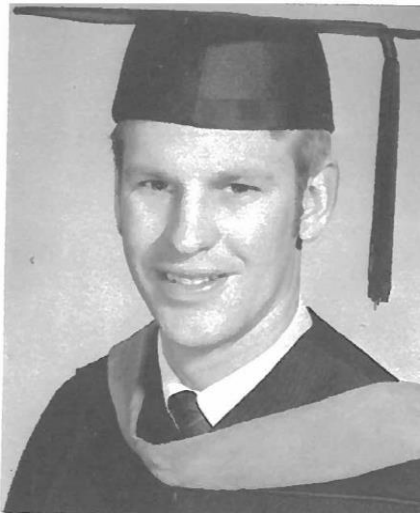




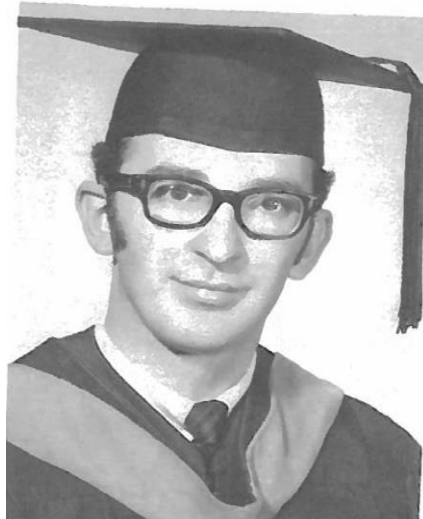
Chicago College of Osteopathy 1967



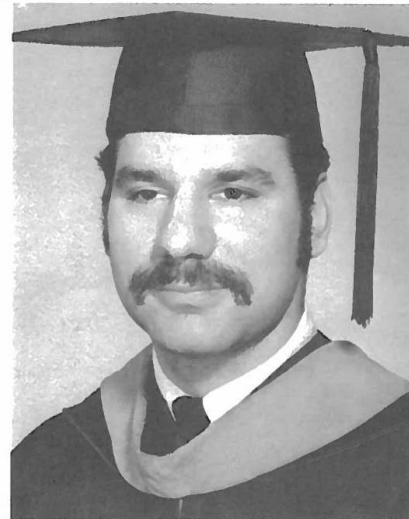
Return of the Dinosaurs



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THE POP STANDS OF CARDIOLOGY

- This delicious menu presents the Physician with the “pen” or now with the “mouse” many options. There are 2 kinds of Physicians : those that order a bunch of tests, (the spaghetti approach) and make the patient fit into it, and those that actually examine the patient and order the appropriate test.

...Remember when all else fails, go and examine the patient!

Pop Stand of Cardiology Continued...

- Test and cost
- EKG
- Lab tests: CPK, Cpk MB, TROPONIN (THE MOST WORTHLESS, ABUSED TEST IN CARDIOLOGY), BNP
- Echocardiography
- Outpatient monitoring
- Stress Tests : Garden Variety, Stress Echo, Nuclear stress
- Imaging Sliced CT (64,128,256)
- The ultimate, Cardiac catheterization



A DISASTEROUS DECISION



- Patient is a 78 year old Caucasian female seen as a pre-operation consult for “ Cardiac Clearance” for cataract surgery.
- **Aside:** firstly we do not “clear” anyone for surgery. We assess preoperative risk and explain that to the patient, and make sure that the patient is optimized clinically for surgery. If surgery is emergent then we do our best.
- The patient got scheduled for a Ragadenosine nuclear study because she was 10 years sp IWMI The study was read as post stress and rest myocardial perfusion imaging revealing a small to moderate area of ischemia in the anterior apical wall, Left ventricular ejection fraction 75%. The patient was scheduled for cardiac catheterization and found to have a 70% lesion in the mid Left anterior descending coronary artery that was calcified. BTW she was on beta blocker, asa, statin and was actively swimming three times per week without symptoms. The operator decided to intervene and perforated the vessel causing a pericardial effusion that could not be sealed. Attempts were made to drain the effusion but unsuccessfully and the patient was taken to the OR , the vessel could not be repaired so it was closed and bypassed. She was difficult to extubate and was in ICU for 5 days, developed renal failure secondary to contrast and was dialyzed for 2 weeks before her renal function improved. She was discharged to rehab and returned home eventually and never had cataract surgery.

What's wrong with this picture?

- There is no need for routine preoperative testing before cataract surgery!
- 19,957 patients were randomly assigned to pre-op testing and no testing.
- Pre-op testing was EKG,CBC,BMP, Hx and Physical.
- Overall complication rate was same 3%: Hypertension and Bradycardia, occasional a fib.
- NO PREOP TESTING INDICATED FOR CATARACT SURGERY
- The patient was asymptomatic on appropriate medical therapy therefore cardiac catheterization not indicated.
- Why: what do surgeons say about surgery? “It’s for other people” In general you can be worse off with a procedure because NO PROCEDURE is without risk.

ICD-10

- I25.19 Atherosclerotic Heart Disease of Native Coronary artery with unspecified Angina
- R93.1 Abnormal findings on diagnostic imaging of heart and coronary arteries
- I31.3 Pericardial effusion (Non inflammatory)
- J58.821 Acute post procedure respiratory failure

.....OTHERWISE KNOWN AS IATROGENESIS
FULMINANS

The always available and easily obtainable “Troponin”

- Patient is a 62 year old Caucasian male with no prior cardiac history. He was playing tennis on a Friday afternoon and in the third set had a sharp pain with movement in the second intercostal space , no radiation down the arm, no diaphoresis. The discomfort lasted for 2 hours and did not worsen so at 4:30 he called his primary Doctor and said he was having chest pain. The receptionist said he could not be seen until Monday but to go to the ER. He went to the desk and said he was having chest pain so the ER Doctor said give him a nitro. He was roomed and an EKG was normal, CPK, CPK and MB normal but the troponin was .11. (.06 -.12), The ER doctor examined the patient and confirmed that the pain was reproducible to palpitations and EKG was normal. Chest pain gone but a second troponin was drawn and was . 13, It was now 8PM . Too late for a stress test so patient was told he could not be sent home and needed to be admitted to OBV. The next morning the Troponin was normal as was the EKG but the admitting service ordered a stress Cardiolyte and the isotope could not be obtained until Monday. Patient remained in the hospital until Monday, still pain free and the stress cardiolyte was negative at 14 Mets. Discharged.

TROPONINEMIA UNNECESSARIUS



Elevations of Troponins without overt Ischemic Heart disease:

- Trauma(including contusion, ablation, pacing, ICD firing, cardioversion, endomyocardial biopsy, cardiac surgery,
- Congestive Heart failure - acute and chronic
- Aortic valve disease and IHSS with LVH
- Hypertension
- Hypotension
- Renal failure
- Chronically ill patients: especially with diabetes, respiratory failure, GI bleeding sepsis
- Drug toxicity
- Hypothyroidism
- Inflammatory disease eg myocarditis, Parvovirus B19,Kawasaki disease, sarcoid, smallpox vaccination,
- Post PCI patient pulmonary Embolism
- Sepsis
- Burns
- Infiltrative diseases including amyloid, hemochromatosis, sarcoid, scleroderma
- Vital exhaustion

Where do most of these tests originate from?...
Its usually not the Arrow but it's the Indian

- The emergency room
- Pre op: “ Cardiac Clearance”
- The issue is why was the test ordered and that is just as important or...Who interpreted the study ?
 - The computer?
 - The physician that just got sued ?

EKG'S

WHAT CONSTITUTES AN ABNORMAL EKG, that does not require a cardiology Consult?

- sinus bradycardia
- incomplete Right Bundle Branch Block
- complete Right Bundle Branch Block
- complete Left Bundle Branch block
- 1st degree AV Block
- left ventricular Hypertrophy
- poor r wave progression from V1 -V3
- non specific ST-T wave changes

is a test abnormal because it is not totally normal, or is it abnormal because it meets criteria for being



In Dealing with the patient that presents “chest pain” which is the best test?

- History: William Heberden’s classic description of angina pectoris was first presented to the royal college of Physicians in 1768. It was published in 1772, in the Medical Transactions of the College. Many aspects of his description are true to this day. There is a disorder of the breast marked with strong and peculiar symptoms, considerable for the kind of danger belonging to it which deserves to be mentioned. The seat of it, and sense of strangling, and anxiety which it is attended make it properly called ANGINA PECTORIS.
- They who are afflicted with it, are seized while they are walking, (more especially if it be up a hill, and soon after eating) with a painful and most disagreeable sensation in the breast, which seems as if it would extinguish life, if it were to increase or continue; but the moment they stand still, all this uneasiness vanishes.
- The pain is sometimes situated in the upper part, sometimes in the middle, sometimes at the bottom of the os sterni, and often more inclined to the left than to the right side. It very frequently extends from the breast to the middle of the left arm.

ANGINA PECTORIS

Michael J. James DO FACOI, FACC

- A visceral sensation, that is initiated by those stressors that increase cardiac output, usually involves the breast bone in some shape or form, frequently migrates to the left arm or jaw , comes on gradually lasts four to ten minutes is relieved when the stressor has run its course and has a predictable relief response within a very short time with a sublingual nitroglycerin.

THE MOST ACCURATE TEST TO ORDER FOR THE PATIENT PRESENTING WITH ATYPICAL FEATURES

- ROUTINE TREADMILL EXERCISE TEST
- STRESS ECHOCARDIOGRAM: walking or
d Dobutamine
- Cardiolyte

REPORTS THAT YOU DO NOT WANT TO GET BACK

- This is a positive exercise electrocardiogram to 14 mets with 1.0 mm ST segment depression in the inferior lateral leads in an individual who has an average level of exercise for age.
- This is an indeterminate 4.5 met exercise treadmill due to failure to reach 85% of predicted HR for this age group due to hip pain, If clinically indicated, pharmacologic nuclear stress test may be useful for further evaluation.
- Post stress and rest myocardial perfusion imaging revealing a small to moderate area of ischemia in the anterior lateral wall. Calculated TID ratio was 1.34 but visually, no significant TID noted, Gated study Left ventricular ejection fraction was calculated at 56% with normal wall motion

What is Absolutely the Most Important
Factor to know about every cardiac patient?



EJECTION FRACTION

MAGIC NUMBER: 35%

- MUGA SCAN
- ECHOCARDIOGRAM
- Left Ventricular gram
- Gated MRI
- Cardiolyte



CARDIAC CATHERIZATION FOR EVERYONE OVER THE AGE OF 60?

- NO FALSE POSITIVES
- ELIMINATES THE NEED FOR ANY OTHER TEST
- RELATIVELY SAFE IN EXPERIENCED HANDS
- GENERALLY DONE AS AN OUTPATIENT
- RADIAL APPROACH



INSTEAD OF HEART CATHERIZATION ORDER A CT

- SAFER THAN
CARDIAC
CATHERIZATION
- OUTPATIENT TEST
- CALCIUM SCORE
ONLY??

Negative; Lots of

HOW OFTEN SHOULD THESE TESTS BE DONE IN A STABLE CARDIAC PATIENT

If any test is being done more than once a year: Find yourself another cardiologist, but better yet why do you need a cardiologist to take care of patients with CAD. Atrial fibrillation, or CHF ????

- Stable CAD no devices, stents, bypasses
- Stable patients post stent (no MI)
- Stable post MI (stent or no stent)
- Stable CABG
- Atrial fibrillation (control the rate, antcoagulate)
- CHF (Digiasixopotena duraregtresto)

PRE-OP “CARDIAC CLEARANCE”

Evaluation of cardiac risk prior to non cardiac surgery

- Low Risk: Reported risk of cardiac death or non fatal MI less than 1%

Ambulatory surgery; Endoscopic procedures; Superficial procedures, Cataract Surgery; Breast surgery

- Intermediate Risk: (reported risk of cardiac death or nonfatal MI 1-5%)

Carotid surgery, Head and neck surgery, Intraperitoneal and intrathoracic surgery, Orthopedic surgery, Prostate Surgery

- High Risk: (reported risk of death or nonfatal MI often greater than 5%)

Aortic and other vascular surgery; peripheral artery surgery

Revised Goldman Cardiac Risk Index (RCRI)

- Six independent predictors of major cardiac complications
- 1: High risk surgery
- 2: History of ischemic heart disease
- 3: History of CHF
- 4: History of cerebrovascular disease
- 5: Diabetes mellitus requiring treatment with insulin
- 6: Preoperative serum creatinine >2.0 mg/dl

STATISTICS

- Rate of cardiac death, non fatal myocardial infarction, and nonfatal cardiac arrest according to the number of predictors
- No risk factors: 0.4%
- One risk factor: 1.0%
- Two risk factors: 2.4%
- Three or more risk factors: 5.4%
- Rate of myocardial infarction, pulmonary edema, ventricular fibrillation, primary cardiac arrest, and complete heart block
- No risk factors: 0.5%
- One risk factor: 1.3%
- Two risk factors: 3.6%
- Three or more: 9.1%

ORIGINAL GOLDMAN CRITERIA

Ischemic heart disease:	Myocardial infarction within 6 months	10
CHF:	S3 gallop or jugular venous distention	11
Cardiac rhythm:	Other than sinus or PACS	7
Valvular heart disease:	Important aortic stenosis	3
General medical status:	P02<60mmHg or PCO2>50mmHg;K+ <3.0 BUN >50, or Cr>3.0 abnormal liver	3
Age:	> 70	5
Angina:	Class 4, (20) unstable within past 6 months	10
Pulmonary edema:	Any history, (5) occurrence within the preceding week	10

CARDIAC COMPLICATIONS:

Points:	None/minor	Life threatening	Death
0-5	99%	0.7	0.2
6-12	93%	5	2
13-25	86%	11	2
>26	22	22	56

METS

- Can take care of self, such as eat, dress, or use the toilet (1 met)
- Can walk up a flight of steps or a hill or walk on the level at 3-4 MPH (4mets)
- Can do heavy work around the house: scrub floors, 2 flights of stairs, lift or move heavy furniture (between 4 and 10 mets)
- Can participate in strenuous sports such as swimming, single tennis, football, basketball, and skiing (10 mets)

A Bridge Too far

- The only patient that needs to be bridged is the patient with a Mechanical Valve, or the patient with recurrent pulmonary emboli,
- Generally patients with chronic atrial fibrillation on Coumadin or Noac's can have them stopped if the procedure can be completed within a 7 day window
- If the procedure involves the spinal column be especially careful Xarelto needs to be held 5 days

PROCEDURES IN PATIENTS WITH STENTS

- ONE MONTH WITH NON DRUG ELUTING STENTS
- SIX MONTHS WITH DRUG ELUTING STENTS



Consumer Reports: Unnecessary cardiac screening test can mislead a patient

- A 53 year old accountant was smiling when he returned from Florida. “ I am going to live forever because my coronaries are normal.”
- He explained that a golf buddy persuaded him to get a checkup from a local cardiologist even though he had no risk factors for CV disease. He had an EKG followed by a stress echocardiogram and since the cardiologist was not satisfied a Cardiolyte Stress test was then done which demonstrated a defect. Two days later now convinced that he was at death's door and would need open heart surgery, he found himself at a hospital, in a darkened X-ray room, undergoing a coronary angiogram. The coronary angiogram was normal and the accountant said he was “ the happiest man in the world.” No matter that he could not play golf for three weeks because of a groin hematoma !!!!!

ALAMONIAPLASTY
BOATGASAPLASTY
SOWHATAPLASTY
GREEDAPLASTY



TOMORROW
STARTS
TODAY.

TESTS I WISH YOU HAVE NEVER ORDERED
ACOI 2017 ANNUAL CONVENTION AND SCIENTIFIC SESSIONS

BLOOD CULTURE ORDERS

STEPHEN J SOKALSKI DO FACOI FSHEA

CULTURE ORDERS FOR SEPSIS

- NURSE: “DOCTOR YOUR ICU PATIENT HAS A FEVER OF 38.8 DEGREES C. WHAT DO YOU WANT ME TO ORDER?”.
- DOCTOR: “DRAW TWO BLOOD CULTURES FROM THE CENTRAL LINE NOW AND FOR A FEVER GREATER THAN 38.5. START GODAMYCIN.”

INDICATIONS FOR BLOOD CULTURES

1. CLINICAL FEATURES OF SEPSIS INCLUDING TACHYCARDIA, TACHYPNEA, INCREASED OR SUBNORMAL TEMPERATURE, CHANGE IN SENSORIUM.
2. SUSPICION OF ENDOCARDITIS
3. FUO
4. LEUCOCYTOSIS
5. SYSTEMIC AND LOCALIZED INFECTIONS

RESULTS

- IN THE NEXT 24 HOURS 3 DIFFERENT SETS OF BLOOD CULTURES ARE DRAWN.
- WHAT'S WRONG WITH THIS PICTURE?

BLOODSTREAM INFECTIONS AND CULTURES

- BLOOD VOLUME IS THE MOST IMPORTANT VARIABLE IN RECOVERING BACTERIA FROM BLOOD
- 20-30 ML PER CULTURE SET
- CHILDREN GRADUATED VOLUMES
- IDEAL TOTAL # OF SETS IS 2-4
- IN ACUTE SEPSIS 2 BLOOD CULTURES FROM 2 SITES DRAWN AT ONCE IS ADEQUATE

BLOOD CULTURES

- BLOOD CULTURES SHOULD BE DRAWN BEFORE ABX ARE STARTED
- CATHETER-DRAWN BLOOD CULTURES = HIGHER CONTAMINATION RATE
- DO NOT SUBMIT CATHETER TIPS FOR CULTURE WITHOUT AN ACCOMPANYING BLOOD CULTURE BY VENIPUNCTURE
- NEVER REFRIGERATE BLOOD CULTURES PRIOR TO INCUBATION

NUMBER OF CULTURES

- CUMULATIVE YIELD OF TRUE PATHOGENS
- FIRST BC = 73% TO 80%
- SECOND BC = 80% TO 89%
- THIRD BC = 95% TO 98%
- FOURTH BC = 99% TO 100%
- ONE BLOOD CULTURE IS RARELY ADVISABLE SINCE INTERPRETATION IS DIFFICULT

BLOOD CULTURES

- CONTAMINATION IS COMMON (0.6% TO > 6%)
- THIS IS COSTLY AND CONTRIBUTES TO OVER TREATMENT AND MISDIAGNOSES
- METICULOUS CARE AND SKIN PREPARATION MUST BE TAKEN PRIOR TO EACH VENIPUNCTURE OR CENTRAL LINE BLOOD DRAW

FALSE POSITIVE BLOOD CULTURES

- 20% INCREASE IN LAB CHARGES
- 39% INCREASE IN ANTIBIOTIC CHARGES
- HALF THE PATIENTS WITH FALSE POSITIVE BLOOD CULTURES WERE TREATED WITH ANTIBIOTICS OFTEN VANCOMYCIN (\$1000 PER PATIENT).

BLOOD CULTURES

- CONSENSUS GUIDELINES AND EXPERT PANELS RECOMMEND PERIPHERAL VENIPUNCTURE AS THE PREFERRED METHOD
- LESS LIKELY TO BE CONTAMINATED THAN BLOOD DRAWN FROM AN INTRAVASCULAR DEVICE
- CHG IS SUPERIOR TO POVIDONE-IODINE FOR SKIN DISINFECTION
- 30 SECONDS DWELL FOR DISINFECTION

CATHETER DRAW VS PERCUTANEUS

- 15% TO 25% OF CVC ARE COLONIZED
- SENSITIVITY OF CATH DRAWS 89% V 78% PERIPHERAL. PPV OF 63% CATH DRAWS V 73% PERCUTANEUS
- CONSIDER DRAWING ONE FROM CATH AND ONE PC
- WHEN 2/2 BC POSITIVE, PPV 98% IF BOTH FROM VEIN, 96% IF ONE FROM VEIN AND ONE FROM CATH AND ONLY 50% IF BOTH FROM CATHETER.

ADDITIONAL BLOOD CULTURES

- DRAW ORIGINAL BLOOD CULTURES FROM AT LEAST 2 SEPARATE SITES PRIOR TO STARTING ANTIBIOTICS
- ENDOCARDITIS HAS CONTINUOUS BACTEREMIA NO MATTER WHEN DRAWN. ALL WILL BE POSITIVE
- NO FURTHER BCS FOR 48 HOURS
- MAY CHECK TO SEE IF BACTEREMIA IS GONE AFTER 48 HOURS (ENDOCARDITIS, STAPH)

CR-BSI

- DIAGNOSIS OF CLABSI IS USUALLY BY EXCLUSION
- A MICROBIOLOGIC GOLD STANDARD FOR DIAGNOSIS DOES NOT EXIST
- NO FIRM CONCLUSIONS FOR RELATIVE MERITS OF DIAGNOSTIC TECHNIQUES
- FIRST IS DOCUMENTATION OF BACTEREMIA
- CATH TIP CULTURE ALONE, RELEVANCE IS UNKNOWN

CR-BSI

- USUALLY THE DIAGNOSIS OF CLABSI REQUIRES EXCLUSION OF OTHER SOURCES
- ROUTINE CULTURE OF CATHETER TIPS AT REMOVAL HAS NO VALUE
- TIME TO POSITIVITY MAY BE USEFUL IF THE DEVICE BECOMES POSITIVE > 2 HOURS BEFORE THE VENIPUNCTURE.
- QUANTITATIVE BC $> 5X$ FROM PORT VS PERIPHERAL MAY BE USEFUL

CONTROL OF FALSE POSITIVES

- DISCOURAGE BLOOD CULTURE DRAWS IN PATIENTS WITH LOW RISK
- DISINFECTION OF CATHETER SITES MAY BE LESS EFFECTIVE THAN PERCUTANEUS SITES.

Outbreak of *E. cloacae* and *K. oxytoca* associated with an Outpatient Chemotherapy Center

John Watson MD
CDPH

Lab Results

- 112 cultures drawn
- 58 patients exposed to flush 2/9 – 3/3
- 54 during period 2/17 – 3/3
- 27 confirmed cases
 - 2 *K. oxytoca* only
 - 20 *E. cloacae* only
 - 5 infected with both organisms

The Outbreak

- CDPH contacted early March:
 - 13 cases of bacteremia among attendees at a Southside chemotherapy center
 - 10 with *Enterobacter cloacae*
 - 2 with *Klebsiella oxytoca*
 - 1 with both organisms

Results, cont'd

- 18 presented with symptoms, 9 identified by blood culture surveillance
- All cases received saline flush during the period 2/17-3/3

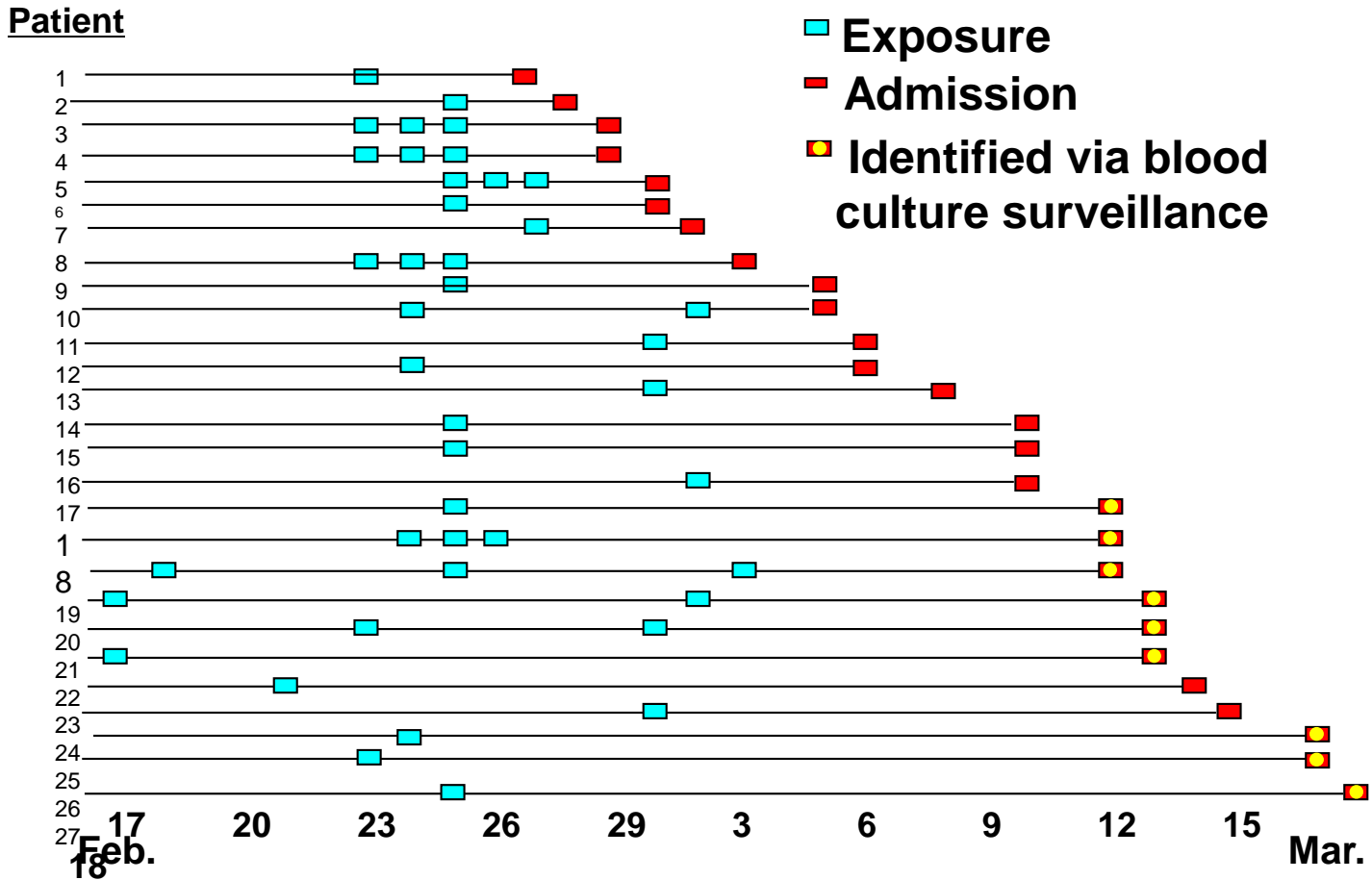
Environmental Sampling

- Saline (opened and unopened bags)
- Dextrose (unopened bags)
- Saline and heparin predrawn syringes
- Tubing (used and unused)
- Swabs of sinks, toilet, doorhandles
- Hand lotion, chemotherapy, disinfectant
- Artificial fingernails of nurse

Summary

- Saline flushes most likely contaminated with *Enterobacter cloacae* and *Klebsiella oxytoca* from 2/17 – 3/3
- 27/54 (50%) exposed to flush during this period developed bacteremia
- Treatment of infections successful

Cases, by Dates of Exposure and Admission

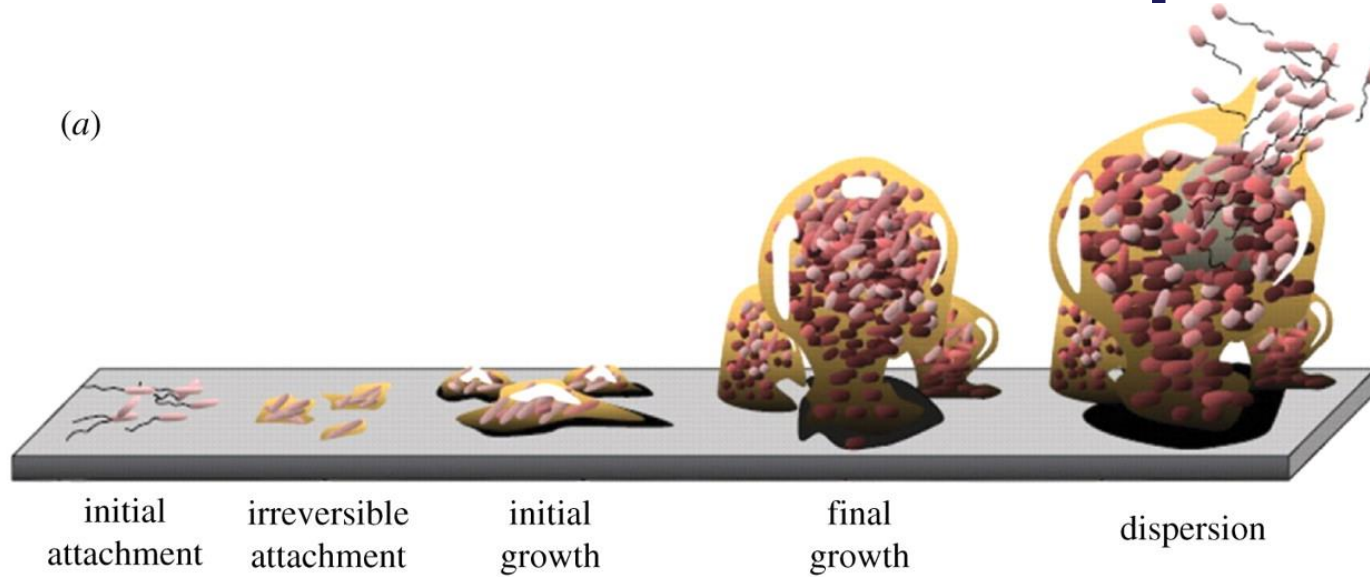


Summary

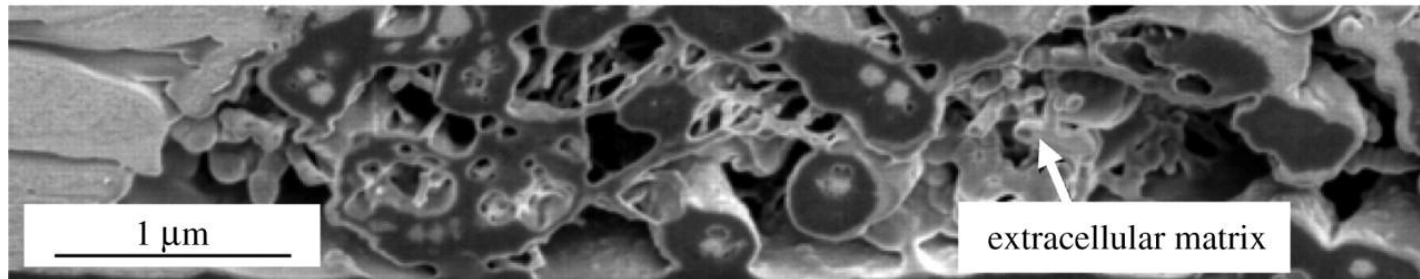
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Biofilm development process and cross-section example

(a)



(b)



Gregory D. Bixler, and Bharat Bhushan Phil. Trans. R. Soc. A 2012;370:2381-2417

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Epidemiology and Prevention of Bloodstream Infections

- Hand hygiene
- Maximal sterile barrier precautions
- Chlorhexidine rather than povidone-iodine for skin antisepsis
- Avoiding femoral access
- Single lumen if possible
- Remove catheter as soon as possible
- Good work organization
- No guidewire exchange
- No routine catheter change

Incidence density

Events per 1000 device-days

Central venous catheter (CVC)

2.7/1000 catheter-days

PICCs

2.1/1000 catheter-days

Tunneled CVCs

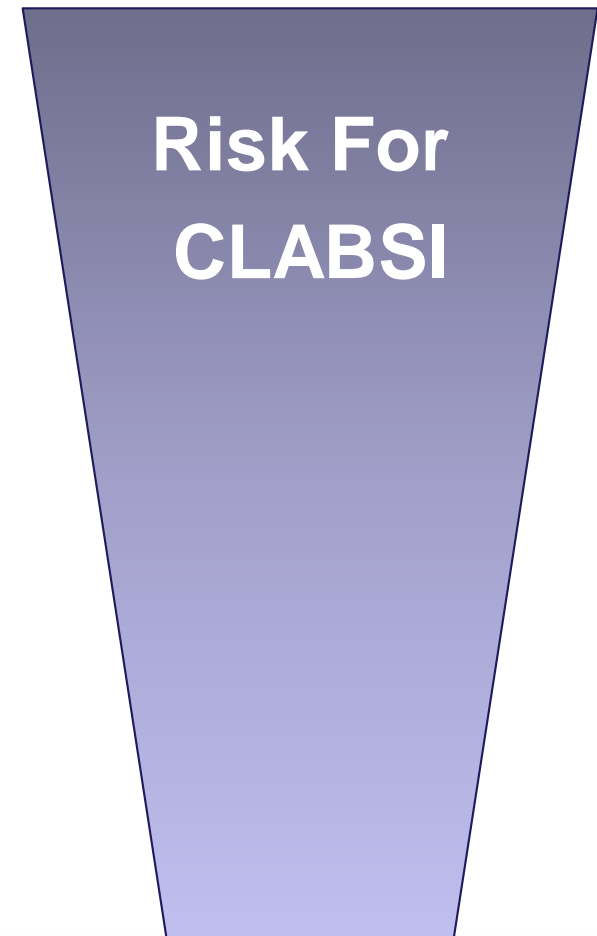
1.6/1000 catheter-days

Peripheral venous catheters

0.5/1000 catheter-days

Implantable port systems

0.1/1000 catheter-days



Epidemiology and Prevention of Bloodstream Infections

Insertion Site

RR

Internal jugular access	1.0-3.3
Subclavian access	0.4-1.0
Femoral access	3.3-4.8

However: no difference of catheter colonization (40.8 vs. 35.7 per 1000 catheter-days) and CLABSI (2.3 vs. 1.5 per 1000 catheter-days) hemodialysis catheters

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